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Contents.

	PAGE
The Age of Semi-Steel	151
Research Work and the Chemical Analysis of Cast Iron	151
Correspondence	152
Catalogues Received	152
An Apprenticeship Course in Foundry Practice. VI.	153
Some Overhead Foundry Runways	157
Metal Breaking with Explosives	158
A Fettling Shop Speciality	159
Use of Carbon Dioxide Recorders in Controlling Combustion of Powdered Coal	159
Melting Steel and Cast Iron together in the Cupola	160
Simplifying Cores for Water-Cooled Journal Box	162
Views on Mr. Smalley's Paper on High Tenacity Brasses	163
Some Notes on Semi-Steel and Loam Moulding	164
Concerning Machine Moulding	164
Prof. Loureda's Paper on Malleable Iron Discussed	165
Discussion on Prof. Campion's and Mr. Donaldson's Paper on Strength of Cast Iron at Low Temperatures	165
Iron and Steel Output in July	166
American Specifications for Semi-Steel Castings	167
The Analysis of Cupola Slag	168
Malleable Castings	169

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The Age of Semi-Steel.

In the second edition (1882) of a book entitled "La Fonderie en France," originally published in 1844, reference is made to a patented mixture containing 60 parts of grey pig-iron, 20 parts wrought-iron scrap, 20 parts of wrought-iron turnings, 3 parts manganese, and 2 parts of borax. What the author meant by manganese it is difficult to say. It might have reference to ferro-manganese, spiegeleisen, or even manganese ore. Further reference to semi-steel is made in another patented mixture, wherein it is recommended to use 3 to 15 parts of steel, semi-steel (demi-acier) or malleable iron to 100 kilos. of ordinary grey iron. Full reference is made to Stirling, who is thought by many to be the originator of semi-steel, but, additionally, the Morries-Stirling process is also dealt with. If any of our readers can throw more light on the origin of the incorporation of steel in cupola charges we shall be happy to have their references.

Research Work and the Chemical Analysis of Cast-Iron.

BY H. J. YOUNG, F.I.C.

"All possible care must therefore be exercised in the initial stage, and the laboratory results examined and checked in the smallest detail."

"So much depends upon the process of analysis resting on an unassailable basis."

"In experimental investigation great attention must be given to detail. Where this is not fully realised, conclusions may be drawn from premises which are either incomplete or incorrect."

The above passages from Dreaper's "Notes on Chemical Research" have some considerable bearing upon the present position in the metallurgy of cast-iron and of ironfoundry practice.

Cast-iron, one of the most impure or, at any rate, one of the most intricately impure materials of commerce, is full of mysteries and contradictions. A study of the literature of cast-iron and its properties and manufacture will reveal this fact to an amazing degree. What is apparently proved by one worker is apparently disproved by another. Take the effect of sulphur, for instance, and it will be found that whilst one man says it is harmful another says it is beneficial, that whilst one pig-iron is commended for its low sulphur-content, exactly the opposite is the case of certain white irons which are equally commended.

The inquiring foundryman is unfamiliar with the difficulties of chemical analysis, as, indeed, are many analysts, and he does not appear to realise that an analysis has in itself no particular standard of accuracy. It all depends; and therefore thousands of analyses, though perhaps quite sufficiently good for their original purpose, are entirely valueless, and even misleading, as proofs of any theory or, possibly, of any fact.

Foundrymen are, for instance, faced with the problem as to why two pig-irons of apparently similar composition give castings of widely different properties. The most unscientific person would probably ask whether one can be *certain* that the compositions *are* similar, and in so asking would be indicate the vital point of the problem, and one that foundry workers have either overlooked or under-valued.

To determine beyond doubt whether two pig-irons or cast-irons do or do not possess precisely similar compositions requires greater accuracy, experience and knowledge than the ordinary analyst is to be expected to have. In the first place, the analyst will have to prove the accuracy of his method and of his way of working that method, and, in the second place, he will need to compare the results obtained by his method with those obtained by other methods; thirdly, he will need to investigate whether his method is applicable, with equal accuracy, to any iron of any composition; and, lastly, he will need to prove that the final result really represents the element he is estimating, or whether it includes other elements or compounds.

Of course, in everyday laboratory practice, this is not done, and in some laboratories it never has been done. One simply uses some method out of a book handled during earlier training. In many laboratories the methods, though good in themselves, are worked wrongly or in a slovenly fashion, or are applied to unsuitable purposes. It takes many years to train a man to be an accurate analyst, and there is no certainty that he will be one even after those years of training. It depends upon the training and upon the man. Some chemists say that analysts are born rather than made. Certainly it is the writer's experience that

not one out of a hundred ordinary boys has the qualities essential to the making of an accurate analyst, no matter how much training he may have—nothing like one in a hundred.

The object of this article is not to prove that there are analysts of differing calibre—that is already well recognised by chemists themselves—but to show that the value of any research upon cast-iron depends almost entirely upon the correct analysis of the specimens under investigation. Some years back one of our leading engineers caused to be prepared a standard sample of cast-iron, which he sent round to a number of laboratories of all kinds all over the country. The results were deplorably poor, and, in many cases, ludicrous.

Naturally, one can hear the foundryman say to himself, "Well, what does it matter if it does differ a little either way? It is merely splitting hairs to talk in this manner about an analysis." Thereby does the unscientifically trained man make an enormous mistake; the success or failure of most things depends more upon small matters than upon large ones, and that is as much true as regards foundrywork as regards anything.

A little, a very little, strychnine will turn a glass of water into a good tonic; a little more, a very little more, will turn the mixture into a deadly poison. In metals and alloys we know of quite a number of things with strychnine-like effects. Ask the metal-rolling trades what they think about minute impurities and small amounts of other additions (not impurities)—they will tell you that they are the principal things to think about in their trades.

In cast-iron it is not yet known what is and what is not important. It must be something exceedingly small that makes two irons have very different properties, even though their compositions are apparently similar. True, it may be something to do with inherent properties, but, on the other hand, it may be due to composition, and, before accepting the former theory, it will be necessary to prove the latter.

The common analysis of cast-iron *includes* carbons, silicon, phosphorus, sulphur and manganese, and it is an exceedingly difficult analysis to make correctly, particularly in certain irons. The common analysis of cast-iron *does not include* titanium, copper, nickel, arsenic, chromium, tungsten, etc., to say nothing of the various gases and compounds of those gases; and, moreover, it is unfortunately true to say that the estimation of some of these things is, at the present time, very indecisive, and, in some cases, altogether impossible.

It is a brave man, and a rash man, who says that the properties of cast-iron do not depend upon composition, and he has got a great deal of work before him if he desires to prove his statement.

Considering one or two concrete and simple cases. Suppose two cast-irons are analysed for the ordinary elements, and one of them is found to contain 0.10 per cent. more silicon than the other, but is the same as the other in all else. Will anyone say that the 0.10 per cent. silicon does not matter and that the irons are precisely alike? Or suppose, instead of 0.10 per cent. silicon, the difference was 0.05 per cent. manganese, or 0.05 per cent. phosphorus, of 0.05 per cent. carbon, or 0.01 per cent. sulphur. Who can say what does and what does not matter? The writer knows of several foundrymen who say these things do not matter, but they are speaking without metallurgical training and are unaware of the possibilities.

Suppose it takes 0.13 parts of A to combine with 0.017 parts of B to form a compound AB; then it follows that, if there are 0.18 parts of A, there will be an excess of 0.05 parts; or, if there are 0.022 parts of B, there will be an excess of 0.005 parts of B. Then suppose that A or B happens to be like strychnine, does it not follow that the slightest excess over that required to form the compound AB will be beneficial or fatal to the result, and this even though the compound AB may, in itself, be comparatively inactive?

Let us therefore start at the beginning, and discover for a certainty the actual values of the various elements in cast-iron. A large job, no doubt, but if a number of enthusiasts work towards those ends, it will be not overwhelming to anyone, however limited may be his facilities.

It will be understood that the above remarks are written for foundrymen rather than for trained chemists. The latter take an analysis with as much salt as is suitable for the brand, while the former are unable to judge the required amount, and are liable even to believe that an analysis—any old analysis—is *necessarily* a perfectly accurate measurement.

Correspondence.

Mr. Cook's American Exchange Paper.

To the Editor of The Foundry Trade Journal.

Sir,—Your leader on the above subject in the Journal of August 10 brings up once again the old question as to the most desirable shape and size of test-bar to be used for testing cast iron. Certainly it would be much easier to compare the results of the different workers in our own and various other countries if the bars were all of one standard design, prepared and cast in a specified manner; but it is not impossible to overrate the value of the test-bar. We ought not to forget that test-bars in themselves are not the "be all and end all" of foundry practice. While they are, of course, necessary in order to show up the strength and suitability of the metal, the castings themselves are, or should be, always first in importance, and undue consideration should not be given to the test-bars as such. In other words, test-bars should be considered in relation to the castings and not independently. The progress of the foundry depends primarily on the castings themselves; first we learn to make the castings, and secondly we endeavour to find stronger and more satisfactory mixtures with which to cast them, always bearing in mind that the metal must be such as to meet the needs of the casting. If the matter be considered in this light, it will be seen that, in our present state of knowledge, no one form of physical test will cover all possible requirements. It may even be, as Mr. Young suggests, a stumbling-block to progress to concentrate too much on one particular kind of test-bar, as, in his opinion, has been done in America.—Yours, etc.,

Ernest Wheeler.

Manchester, August 19.

Catalogues Received.

W. H. A. Robertson & Company, Limited. Air compressors.

Robert Spelling & Company, 88, Chancery Lane, London, W.C.2, "The service we render."

Alldays & Onions, Limited, of 40-44 Holborn Viaduct, London, E.C.1, List M.T., being an abridged list of their general catalogue. This firm issue some 22 sections, together with a binding case, provided with a tabulated index. Firms having such a holder are registered, and are sure of receiving new editions as published.

Visit to Keighley Laboratories.—Members of the Burnley section of the Lancashire Branch of the Institution of British Foundrymen are to inspect the Keighley Laboratories on August 26.

Railway Situation in Canada.—Cables from Montreal state that the threatened strike of the railway shopmen has been averted temporarily, owing to the action of the Presidents of the Canadian National Railway, the Grand Trunk Railway, and the Canadian Pacific Railway, in telegraphing to the Premier rescinding the recent wage cuts in conformity with the view that the railways should accept the ruling of the Department of Justice, viz., that the reduction is illegal before the Conciliation Board has acted.

Electricity in New Zealand.—A report to the Marawatu-Orona Electric Power Board in New Zealand outlines a scheme for hydro-electricity distribution involving an expenditure of £434,439. The Board has decided to borrow £500,000 to carry out the undertaking. In connection with the Mangahao hydro-electric scheme in the North Island of New Zealand, tenders have been called by the Public Works Tenders Board for the supply of plant as follows:—Power-house transformers, sub-station transformers, electric travelling cranes, ventilating fans, goods lift and 110,000-volt insulators. Tenders close on October 3.

An Apprenticeship Course in Foundry Practice.—VI.

By Ben Shaw and James Edgar.

NOTES ON PATTERN-MAKERS' TOOLS.

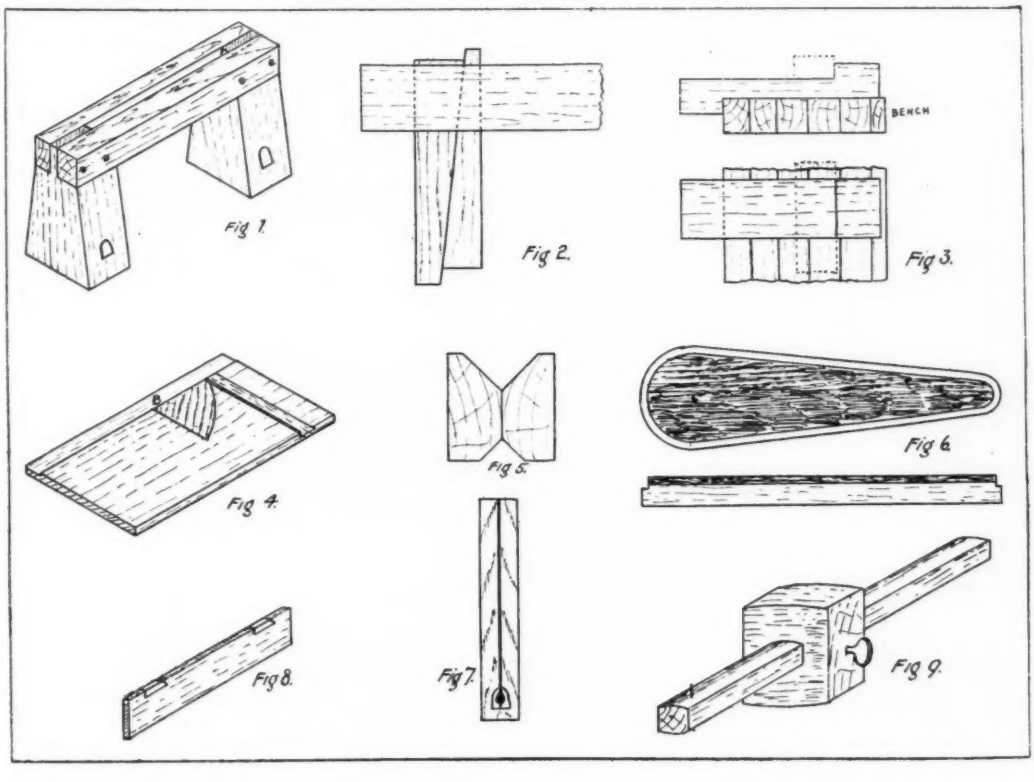
It would be very difficult if not impossible to give instructions on the actual use of pattern-makers' edge tools that would be of value to the novice, therefore we shall not attempt to do so. There are many general considerations, however, dealing with the care of tools and their specific uses which do not require to be demonstrated to be understood, and which might well be considered by older hands as well as apprentices. Pattern-makers' tools may be classified for convenience under three heads, viz., bench equipment, setting out and testing tools and edge tools.

Bench Equipment.

The pattern-makers' bench differs from the cabinet-makers' bench in that the latter is usually provided with two vices and cupboards, whereas the pattern-maker has one vice and one drawer. The best form of bench is that in which the front half of the top is made of 1½-in. or 2-in. yellow pine about 3½ in. or 4 in. wide, bolted together with the annual rings vertical. This makes a very reliable planing surface, and it wears regularly. Sometimes plane tree or sycamore of about 1½ in. thickness is used for bench tops, and if care has been exercised in machining them straight and out of winding they are valuable as surface tables for the smaller class of work made on the bench. Straight-grained wood is necessary to prevent twisting preferably with the annual rings vertical for increased wear. A rack should always be fitted to the back of the bench or in the case of a double-bench a centre back should be made similar to Fig. 1 to hold all edge tools. This is much better than cutting a slot in the bench top, and much safer. A strip of thin wood at the top end of the bench forms a support for the planes and prevents their cutting edges being snipped by resting on the wood. Little need be said about the vice except that the most convenient form is the iron quick-acting vice. Another form of vertical vice is the Emmott vice. Although not quick-acting it is very valuable to the pattern-maker because it can be adjusted to varying angles, an advantage when shaping the work.

Bench Stops.

The bench stop, the object of which is to prevent work from slipping on the bench while it is being planed, is indispensable, and is made in many forms. Adjustable iron bench stops have much to recommend them, although the result is disastrous to the plane iron if the timber which is being planed slips. Some pattern-makers are satisfied with nailing a strip of thin wood to the bench, but one of the most serviceable bench stops is the double-wedge type shown at Fig. 2, which is readily adjustable. A hole 2 in. square has first to be cut through the bench top, the stop then fitted as one piece and sawn in two with a fine dimension saw.



Bench Hooks.

The bench hook is a useful bench tool not generally used. When cutting short lengths with the tenon saw it is very convenient and prevents danger of spoiling the bench tap. One shoulder grips the front of the bench while the timber rests against the other. (Fig. 3.) When about 5 in. wide it is also useful as a paring board, to which an apprentice should become accustomed in order to protect the bench top.

Shooting Boards.

The shooting board is not as much used now as formerly, because practically all pattern-shops are equipped with trimmers, but the apprentice ought to understand the use of the shooting board, and every bench should have one. They are useful for many purposes, one of these being the jointing of segments. Fig. 4 shows a typical form of shooting board. The segment or piece of timber to be planed rests on top surface as shown, the stop being a strip of hardwood dovetailed across the width of the board. The plane rests on the recess B.

C

Fillet Boards.

Akin to the shooting board is the fillet board on which special fillets can be planed. This is usually made about 2 ft. long and of two pieces screwed together (Fig. 5), although the recess can be readily cut from solid timber at the dimension saw by setting the fence at an angle of 45 deg. and raising the saw to the desired height.

Oilstones and Strops.

An essential part of bench equipment are the oilstones and the strops. There is no tool in the pattern-maker's kit that is of greater importance than the oilstone because the condition of all the edge tools depends upon the condition of the oilstone. It is impossible to sharpen edge tools on a gritty stone or one that is not absolutely level. It is quite impossible to get satisfactory results from a cracked stone or one with broken edges. The apprentice should cultivate a habit of levelling his stone at least once a week, and also smoothing his gouge-slip. One or two rubs on a sheet of emery paper suffice to remove irregularities, the emery paper being placed on a bench surface such as a machine table. Many use the sand-papering machine for levelling stones, a method which is never satisfactory to the stone, and in addition it has a ruinous effect on the sand-paper of the machine, and should not be encouraged. With regard to the oil that is used in sharpening, any oil other than linseed is suitable. Linseed oil clogs the pores. Sperm is good; olive oil is also satisfactory, but ordinary sweet oil is as good as either.

Natural or Artificial Stones?

Are natural or artificial stones the better? There is more choice of form and grade with artificial stones, and a very useful feature is that a stone can be obtained with one face coarse and the other fine. A coarse stone is necessary for turning tools and for removing small snips from chisels or plane irons, and nearly all pattern-makers have a special stone for these. There are several kinds of natural and artificial stones, but to rub up a fine edge on carving gouges or thin chisels the Arkansas is unequalled. It is hard and the grain is exceedingly fine, therefore it is slow. A good Turkish stone is a valuable asset to the pattern-maker, but the right grade is so difficult to obtain that those who possess one prize it highly. Washsta stones are coarser and cut more rapidly, but they are quite satisfactory. The best known of the artificial stones is Indian oilstone, which is made of Indian corundum.

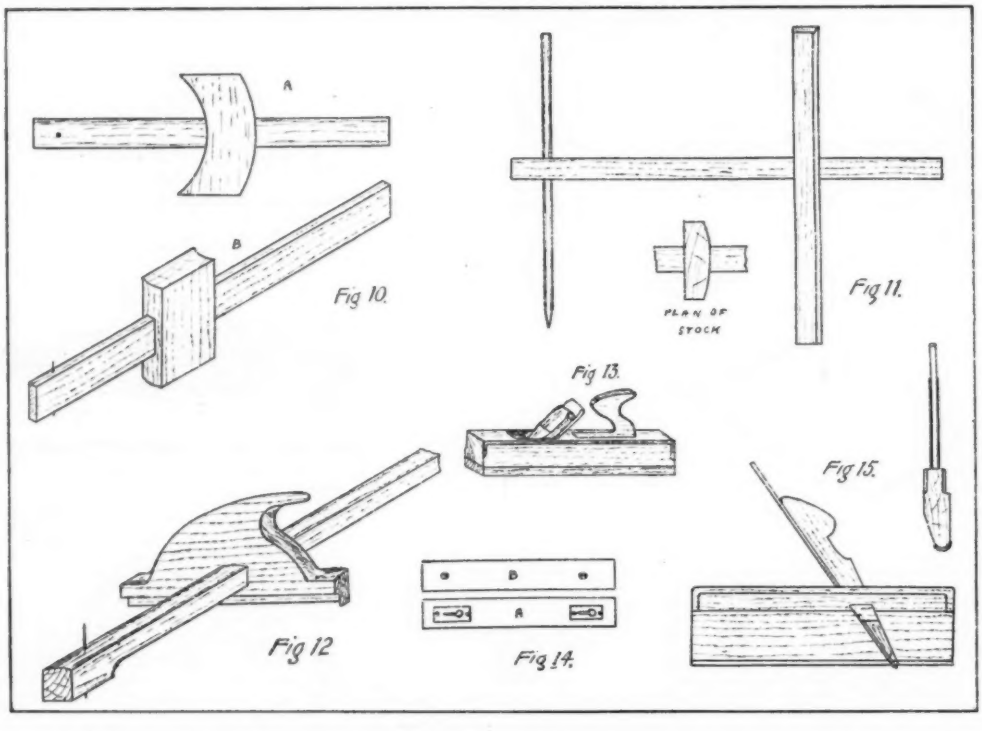
A broad stone is always preferable to a narrow one. A sensitive touch is valuable in determining whether a stone is coarse or fine. Soft places on a stone can be detected readily with a moist sponge because they absorb the moisture more readily. Flat stones should either be held in an iron stand or fitted into a hardwood case with a lid to exclude dust. Cases are sometimes coated inside with white lead and the stone bedded in, a practice which is unnecessary and inadvisable. Gouge slips should also be fitted in cases as they are easily broken.

Strops.

With regard to strops, sometimes a strip of leather is glued on top of the oilstone case and this is admissible if a cover is made for it. It is very important that the strip should be covered. A strop is also necessary for gouges. Different forms of gouge strops are used, but the tapered leather strip mounted on timber and covered is as good as any. An illustration of this is seen in Fig. 6.

SETTING-OUT AND TESTING TOOLS.

A good standard rule is the pattern-maker's most useful measuring tool. A steel contraction rule is also a necessity, and it ought to be marked for steel, iron and brass, although the young pattern-maker may be warned against allowing himself to become the slave of his contraction rule. For comparatively small work it is reliable; for large work it is merely a useful aid.



Try-Squares and Set-Squares.

Try-squares with blades 4 in. long to 3 ft. long are used by the pattern-maker. The American combination square is almost invariably used now, but the pattern-maker should make his own large wooden square of oak or mahogany. Set-squares are also invaluable, and are generally made of hardwood. The construction of a large try-square is not really difficult. The width of the blade and stock should depend on the size of the square; 2½ in. is a satisfactory width with a blade ¼ in. thick set into a stock about ¾ in. thick. Care is necessary in jointing the blade and the stock in order that there may be little difficulty in trueing it up afterwards. The correct joint to make is shown by Fig. 16, and after the blade has been glued and pressed into position it is advantageous to insert dowels as shown. Before the blade is

glued, however, it ought to be tested on a flat board, and a good practice is to glue with buttons —small blocks—fastened on both sides of stock and blade.

Fig. 17 is an illustration of a form of set square which is very handy for use on large work. The usual shape of a pattern-maker's set-square (Fig. 18) is not satisfactory or reliable for sizes over 18 in. With both try-squares and set-squares occasional trueing up is necessary. Attention may be drawn to the protractor on the set-square on Fig. 18, which is useful for setting a bevel to a required angle.

Spirit-Levels and Plumb-Bobs.

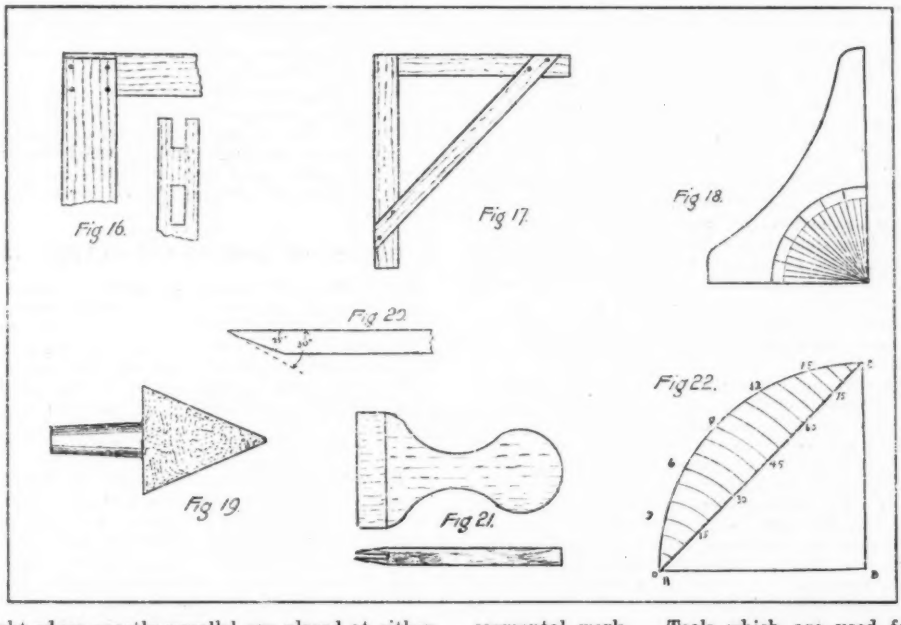
In large marine pattern-shops where the work is usually built on level floors, spirit-levels and plumb-bobs are used. They are also used when setting work in the foundry pit. Combined levels and plumbs are made now, but many pattern-makers still prefer the old-fashioned form of plumb shown at Fig. 7. This may consist of a stick 5 or 6 ft. long and about 5 in. wide carefully planed and with a gauged centre line.

Pattern-makers make their own straight-edges usually of mahogany and of different lengths. No other method is quite as good as winding straight-edges for testing large planed surfaces. If two straight-edges exactly parallel are placed at either end of a planed surface and "sighted" the slightest inaccuracy can be detected. If two strips of wood of a different colour from the straight-edges are inset into one of them and this is placed on the work at the end farthest away they constitute a distinct improvement (Fig. 8). Boxwood strips are usually fitted into mahogany straight-edges, although sycamore or other light-coloured hardwood can also be used.

Gauges.

The surface gauge is not greatly used by pattern-makers, but it is very handy. The ordinary marking gauge is the most useful gauge, but a long-toothed or spider gauge for depth is almost a necessity, and other valuable gauges are those known as panel gauges and circle gauges. Designs for gauges are not altogether stereotyped, and many men originate new forms of gauges to suit certain work. The customary form of marking gauge is as shown at Fig. 9, with stock about 7 or 8 in. long, and there are many wedge and screw methods of fixing the head, and the choice is determined by unexplainable personal liking rather than the superiority of one method. It is a simple tool, but some practice is required for good results. The head is gripped between the thumb and first two fingers and held firmly while being pressed against the edge of the wood. Two forms of circle gauges are in common use, one of these is very similar to the bench-gauge (A, Fig. 10), but it does not accommodate itself very well to a variety of curves, and the thin head-gauge (B, Fig. 10) is a better tool. The long-toothed or spider gauge is nearly indispensable. This may be made to also act as a surface gauge. The simplest form is shown by Fig. 11, the head being about 7 in. long by 1½ in. or 1¼ in. wide, the shaft about ⅝ in. square and the pin, say, 3-16 in. in diameter. Some craftsmen make very fine spider gauges in metal, but the form shown serves very well, and is easily made by the apprentice. The panel gauge, because of the length of the shaft, which may be 2 ft. long, is made somewhat different from the shorter gauges. The shaft is raised from the wood by means of the recess in the head, and the shape of the end of the shaft. thus freer action is obtained. This will be clearly seen in Fig. 12.

Trammels, compasses, dividers and scribers are used by the patternmaker for setting out work and inside and outside callipers for testing work. Double-ended callipers are convenient for testing thicknesses, especially if a pattern is being made from an old casting, but other forms of thicknessing callipers are equally as good. Trammels with adjustable points are very useful for building



segmental work. Tools which are used for an infinite number of purposes are hermaphrodites, commonly called "jennys," and by some odd-leg callipers.

Cutting or Edge Tools.

Whole volumes have been written on the theory of cutting tools, and the subject is a most engrossing one, although it can only be dealt with superficially here. The pattern-maker chiefly uses three planes, the trying plane, or half-long, as it is called in Scotland, the jack plane and smoothing or "hand" plane. Those planes are called bench planes, as they are so often in use that they are seldom removed from the bench. Wooden planes have gradually given place to iron planes with screw adjustment. The jack plane is the roughing plane; the trying plane is used for finishing straight surfaces, and the smoothing plane is for finishing surfaces that do not require to be accurately level. The rabbet plane, either of wood or iron, is much used for recessing, and is always more satisfactory for this purpose than the router. The router should only be used when, because of the width or depth, it is impossible to use a rabbet plane. A plane, which is described next, capable of taking soles for both hollows and rounds is serviceable. Such round sole-planes are invariably made by the pattern-maker himself, and it is quite common and satisfactory to convert a jack plane for this purpose, at least for large work, a smaller

and narrower plane being more suitable for small radius curves.

Sole-Planes.

For special brass or iron round sole-planes much can be said, but when a jack is used with loose soles it reduces the number of tools, which is important. Even a young apprentice can quite easily alter a jack-plane for this purpose. A thickness of $\frac{1}{8}$ in. should first be gauged from the bottom face of the plant and removed at the circular saw, afterwards planing the face square with the sides. Soles should be planed a parallel thickness, and slot plates—usually made of sheet brass—fitted into the stocks while screws are inserted into the soles with their heads projecting to slip into the slots. Fig. 13 is a view of the plane with a sole attached, while in Fig. 14, A represents the bottom face of the plane showing the slot plates, while B represents a loose face with screws. A loose sole may be made to restore the jack-plane to normal use. Considerable care has to be taken in cutting through the mouth of the plane. Some text-books on pattern-making state that several rabbet planes are necessary, but while a very narrow one is at times useful, the average pattern-maker gets along comfortably with a $1\frac{1}{4}$-in. plane. One important advantage of the wooden plane is the skewed iron when planing across the grain. Small fillet planes are still necessary tools. These may be bought, but they are quite easily made; they have to be made in different widths according to the radius of the sole, and about 7 in. long. One of these useful planes is shown at Fig. 15. As in the case of rabbet-planes, the irons have no cover plate, and a different form of wedge must be used, because of their narrow width.

Another form of round sole-plane is the circular plane or "sow back." It used to be quite common for pattern-makers to have a set of these planes, all of them small for various radii, and one larger plane with a few soles; but the adjustable iron plane in which the sole is made of a flexible strip of steel, which by an ingenious device can be adjusted to almost any radius, is very generally used now, and gives better results than the old-fashioned types.

There are not usually cover irons on round sole-planes; consequently great care has to be taken when the grain is awkward. The cover iron is almost a necessity for the ordinary bench planes, and especially for the trying and smoothing planes. When a plane is pushed forward the projecting edge of the cutting iron cuts a shaving which bends upwards and escapes through the top. The best results are obtained with a plane which has a narrow mouth, as when the weight of the plane and the craftsman are pressed on the timber, splitting cannot occur ahead of the cutting edge. The cover or back iron is also an important factor, because when its edge is close to the cutting iron it breaks the shaving quickly and prevents the grain from tearing. Thus when planing troublesome surfaces the cover edge should be less than 1-32 in. back from the cutting edge.

Grinding and Sharpening Tools.

A few words on grinding and sharpening tools may not be out of place, although a little experience is worth volumes of advice. Some foremen attach so much importance to the grinding of tools that they watch new hands at the grindstone and form an opinion of their worth from the degree of skill which they show. Tools cannot be sharpened properly on a badly-conditioned oilstone, neither can they be ground satisfactorily on a grindstone the surface of which is all lumps and hollows. Slow grinding is better than quick grinding. The edge should be held square across the stone, and only gentle pressure applied with the left hand, the tool handle being gripped with the right. It is more difficult to grind plane-irons than chisels, because of their greater width. The experienced workman can tell by sound if the bevel is resting properly on the stone. When the tool is removed for inspection, to return it to its former position it is convenient to bring that part of the bevel nearest the operator in contact with the stone first and then raise the right hand until the whole of the bevel is in contact. To get a keen edge the bevel should be fairly long. A good supply of water is essential to prevent the tool from heating, and before finally removing it it should be allowed to rest very lightly on the stone. If plane irons are ground round they cannot be satisfactorily sharpened on the oilstone.

In sharpening edge-tools on the oilstone the rubbing action should be regular and steady and the fine wire edge may be removed by placing the back of the tool flat on the stone, and rubbing very gently. The angle at which the tool is sharpened should be slightly more obtuse than the grind as shown at Fig. 20. Plane irons should be rounded slightly at the corners to prevent them from scratching the face of the timber. Inside gouges are frequently ground on the grindstone edges when special emery stones are not part of the shop equipment, but emery cones are more satisfactory (Fig. 19). These emery cones may be easily made. A piece of hardwood is turned conical with a tapered shank which can be pressed tightly into the lathe spindle. The surface of the cone is coated with glue and dipped in emery. After two or three applications of emery and the glue has quite dried the cone is ready for use.

We shall not attempt to enumerate all the tools used in pattern-making, but some tools are used only for specific classes of work. The draw knife is not in general use nor the axe, but they are useful in shops where ships' stern frames, stems and propeller brackets are made, for roughing down built work which cannot be conveniently taken to the band or circular saws.

The young pattern-maker often makes a mistake of striking paring-chisels and gouges with the hammer. It is a safe rule that iron should never be used for striking wood or wood for striking iron. A good hard wood mallet is an important tool, and should always be used for striking tool handles.

THE USE OF MARKING AND CUTTING TOOLS.

In marking off timber the most accurate results are obtained by transferring measurements from the rule to the surface by means of trammels, compasses, or dividers. Both cutting edge and point of scriber should be sharp, the cutting edge only being used for marking across the grain, and the point for marking lines parallel with the grain.

Marking-off Tools.

Before timber is marked off it is necessary in nearly all cases that one face and one edge should be planed straight and square. It is not possible to get the twist out of timber by planing diagonally across the grain. The neophite will always find that a better result and quicker is obtained by holding the plane parallel with the grain. An exception may be made when making irregular surfaces level, particularly when much timber must be removed in the process; then the plane may be used at an angle with the grain for roughing purposes. The most twisted-grained timber is workable if the plane iron is sharp. It is somewhat different with a chisel, however, and it is often necessary to pare across the grain, the bevel side being on top. Pattern-makers should endeavour to acquire such skill in paring vertically that a square for testing is almost unnecessary. The chisel should practically finish the work, sandpaper being used merely to smooth, and when used it should always be wrapped round a rubber with a linoleum or cork face to obviate hollows or rounds. The same remark applies to gouge paring.

Gouges.

No arbitrary list of gouges and chisels can be made out, because pattern-makers differ so much in the use of tools, and edge-tools in particular. The kit cannot contain too many gouges, as the best work is done with a gouge just slightly quicker—of smaller radius—than the work being pared. The highest skill cannot substitute proper tools, and it is impossible to make a satisfactory finish of a large radius with, say, a 1-in. gouge. Crank gouges have become very popular, and every pattern-maker should have a few for corebox or other work where hand clearance is advisable or necessary, but it is not wise to use crank gouges

for vertical paring, as one has not the same control of these tools when used vertically.

Chisels.

With regard to chisels, some men prefer 1¼-in. chisel for general work, while others like 1½ in. It is just as one begins. There should be at least half a dozen chisels in the kit from ¼ in. upwards. For very fine work 1-16 in. chisel is very useful. A good selection of spoon and bent carving gouges is required in pattern-shops where work is fine and intricate. It is seldom that pattern-makers have sufficient carving gouges to render them independent of their shop-mates.

Hand saws are less used in pattern-shops now than was the case at one time, because nearly all shops have circular saws and bandsaws. Even small foundry pattern-shops have generally a machine saw of some kind. The chief use of the cross-cut saw is in breaking out timber. Comparatively few pattern-makers have a ripping saw. The tenon saw cannot be dispensed with, and is one of the tools most frequently used. When in good condition and in the hands of a skilled man the result is so satisfactory that it is almost unnecessary to plane or pare a face that has been sawn. The dovetail saw is very useful for fine work, and the keyhole or pad saw is still occasionally used.

Hammers.

The claw hammer is not much used by pattern-makers, a pin or pene hammer being the usual type. Other important tools are screwdrivers, a brace and bits, bevels, clamps and bradawls. The spokeshave is not as indispensable now as at one time, because sand-papering machines are installed in most pattern-shops, but there are still plenty of uses for it. The iron spokeshave with screw adjustment is superior to the wooden type. It is necessary to make a holder (Fig. 21) for the blade while sharpening.

Scale of Chords.

No pattern-maker's kit is complete which does not contain several scales. One of the most important of these is the scale of chords; others,, such as the odontograph and a scale of wheel proportions, will be explained in a later article. A scale of chords is a distinct acquisition which takes up very little room, and although not in every-day use the apprentice should make one, as it is of great assistance for some classes of work. With its aid angles can be determined accurately on a drawing card. The method of making such a scale is illustrated by Fig. 22. Describe the quadrant A.B.C. and bisect it at point 9. Then divide each part into three equal parts by trial. This will give points 3, 6, 12 and 15. Divide these parts also in three, when each part will measure an angle of 10 degrees. The chord A.C. must now be drawn, and the points transferred to it and numbered 5, 10, 15, etc. The points on the chord must now be transferred to a prepared piece of hardwood resembling a rule and longer than the chord. To illustrate the use of this scale let us suppose that an angle of 75 degrees is required. The distance 0 to 60 (in all cases) is taken as radius and an arc drawn, and then the distance 0 to 75 is lifted and marked on the arc.

The protractor, such as is frequently drawn on the set square, is also used for measuring and marking angles. Precision protractors are obtainable for use on the blades of iron squares.

WORK is about to be resumed on the laying of a double-line track from Clydach to Cwmgorse in the Swansea Valley, for the Great Western Railway. Messrs. Walter Scott & Middleton, the Westminster engineers, who began the work before the war, ceased operations in 1914, and have now secured the contract for the completion.

PRELIMINARY work on the site of the new capital power station at Lydney is about to be commenced. The station will eventually have an output of over 20,000 kw., and will cost, with the transmission lines, etc., about £500,000. Power at 33,000 volts will be supplied to collieries and other industrial undertakings in the Forest of Dean and the Stroud Valley. The West Gloucester Electricity Supply Company is to be formed to carry on the undertaking.

Small Overhead Foundry Runways.

A recent issue of "Engineering and Industrial Management" describes a neat and ingenious device which has recently been introduced in Germany; it runs on I-beams, and is fitted with a small electrical winding gear. It is particularly suitable for placing flasks in position, lifting the top off, rapping the pattern and placing the core. This device presents a number of distinctive features. The method employed is unique, and it is the only lifting device of its kind which dispenses with a lifting drum.

The method is as follows:—The lifting chain is of somewhat peculiar construction; it consists of alternate links of two kinds, one being a double joint and the other a machined worm or screw section. The whole has the appearance of a very flexible snake. The lifting and lowering is performed by a small pitched-toothed wheel in a horizontal position in the carriage through which the chain passes. The boss of this wheel is extra long —in fact, so long that two of the worm links are always in pitch with the machine-cut thread inside the boss of the wheel. It will thus be seen that if the wheel revolves in a clockwise direction the chain is pulled up, and reversely it is lowered. The method by which the links are joined together permits movement only in two planes, so that the chain cannot revolve round its axis, since also

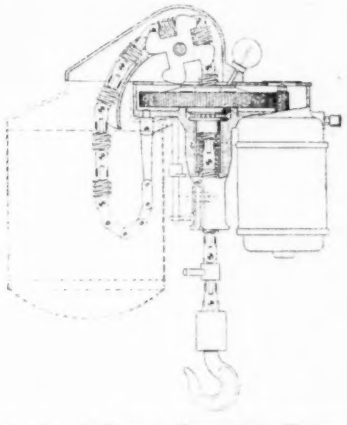


FIG. 1.—A SMALL OVERHEAD FOUNDRY RUNWAY.

that portion which is out of use is passed over a small sprocket in the housing of the gear by which it is guided into a receptacle in order to be out of the way of foundry sand and other dirt. One of the obvious advantages of this chain device is the avoidance of speed reduction gear between motor and lifting device, which is generally of the worm and worm-wheel pattern. The electro-motor is in a vertical position, and carries on its spindle merely a small pinion which gears into the above-mentioned wheel. This apparently complex arrangement is, in reality, extremely simple, and will be better understood by reference to the accompanying diagram. The motor is reversible for lifting and lowering, and it is also automatically reversed by the lifting chain itself when it reaches its end position. There are six speeds, both for lifting and lowering, and any change in speed can be effected by a stationary handle which hangs down. There are two such handles—one for lifting and lowering, and the other for speed regulation. The slowest speed is extremely slow, so that the cope can be lifted off so gently that the mould is in no wise injured. As soon as the flask so lifted is clear of the pattern the speed is increased at the discretion of the operator. Similar tackle is likewise fitted with a second motor if required for travelling. This runway is patented in this country.

MR. P. MIDGLEY has severed his connection with Messrs. Gaston, Limited, of Larden Road, Acton Vale, London, W.3, and is now London manager for Messrs. Haighs (Oldham), Limited, 117-119, City Road, E.C.1, machine tool and woodworking machine manufacturers.

XUM

Metal Breaking with Explosives.

For all metal breaking operations, including ship-breaking, both above and below water, dynamite is specially recommended for general use owing to its high velocity and its certainty of propagation.

The following information, supplied by Messrs. Nobel Industries, Limited, of Nobel House, Buckingham Gate, London, S.W.1, especially as regards the quantity of explosive necessary, is drawn up merely to serve as a rough guide and to indicate the usual operations entailed in the use of explosive for metal breaking. It will be understood that in work of this nature no rigid rules can be laid down, and the operations in each individual instance can only be judged in the light of previous experience and carried out after preliminary trials.

Cast Metal by Plaster Shot.

The action in breaking cast metal is purely one of fracture by shock as distinct from a cutting action. For this reason the cartridges forming the charge are placed together in the centre of the metal plate, and the charge is not made to extend the full length of the metal to be broken, but is preferably concentrated at the strongest part of it. The metal may be scratched with a chisel in the direction in which it is desired to fracture, and should be thoroughly washed and freed from grease before the charge is applied. The charge should be completely covered with clay pressed firmly down. Cast metal fly wheels can be broken up easily by this method.

Steel Plates by Plaster Shot.—The action in breaking steel plates is essentially one of cutting, not of fracturing as in the case of cast metal, and consequently more explosive is required to carry out the work. The explosive charge must be placed in close contact with the metal along the whole length of the part to be cut, the cartridges packed closely end to end so as to ensure continuity of the charge, and the clay pressed firmly over. The best results are obtained if the surface of the metal is previously roughened by chisel and grease removed.

Malleable Iron.—Owing to the tough nature of the material, 25 per cent. more explosive is required than would be used under the same circumstances with steel.

Heavy Metal Castings.

Heavy metal castings in the form of blocks cannot as a rule be broken by plaster shots.

A hole, usually about one inch diameter, is drilled into the centre or strongest part of the block and slightly past the centre, so that the final bursting charge will be as near as possible to the centre of the block. Chambering the bottom of the borehole is generally necessary in order to concentrate the final charge in the centre. The chambering is carried out by firing preliminary charges in the borehole, and the amount of chambering necessary depends, of course, on the size of the final bursting charge required, namely, on the size of the block. In the chambering shots no stemming is required further than firmly plugging the top of the hole with paper or any other convenient material. For the final shot the explosive used should not more than fill the chamber, and the borehole should be filled to the top with stemming firmly tamped. If the explosive charge is not properly centred and fills a part of the borehole so that there is too little stemming, the top part of the metal has a tendency to fly, and the bursting effect of the shot will be lost to some extent.

FIG. 1.—CAST-IRON PLATE, 5 FT. SQUARE, 2 IN. THICK, BEFORE BLASTING.

FIG. 2.—CAST-IRON PLATE AFTER BLASTING BY PLASTER SHOT.

Heavy Metal Vessels.

A hollow casting in the form of a containing vessel, such as a retort or still, can be reduced very easily and cheaply to scrap, of dimensions suitable for handling, by the explosion of a suitable charge suspended in the middle of the vessel, after the latter has been filled with water.

The vessel is filled to the brim with water, and the charge, made up in a waterproof bag and containing an electric detonator, is suspended in the centre of the vessel and fired electrically. If the proper weight of charge is used, the vessel will simply collapse, and the fragmented metal will not be thrown to any extent. A vessel six to seven feet in diameter and six feet deep, the metal of which is two to three inches thick, can be demolished in this way by a single charge of one and a-half pounds of gelignite 50 per cent. N.G., which is the most suitable explosive for this operation.

Boilers and similar heavy metal containers can also be dealt with in this manner.

The breaking of pig-iron into small lengths suitable for the cupola is another useful field for the explosion method.

This method is recommended for use wherever it can be made applicable in view of its simplicity, economy, and the rapidity with which the work can be accomplished.

Breaking Concrete Foundations.—The demolition of concrete and reinforced concrete work,

which is a slow and tedious process by ordinary methods, may be greatly facilitated by explosives. By the proper placing and loading of the holes the solid mass can be broken into material of a size which will permit of easy handling.

Precautions.

In metal breaking operations there is always a danger of debris flying, especially where shots have been overcharged or improperly placed.

To prevent flying debris as far as possible, the metal to be broken should always rest as solidly as can be arranged, and for plaster shots the explosive should be placed above the metal to be broken so that the force of the blast is directed downwards.

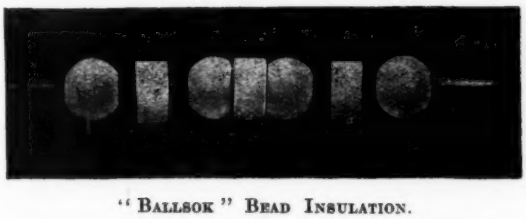
In restricted areas or public places, blasting mats, made of hemp rope or steel wire or chain, may be used to cover the shots and catch any flying fragments. In the absence of specially prepared mats, old hemp or jute bags and such like material heaped over the shot are commonly used, and make an efficient substitute, while brushwood, heavy planks, etc., are also used for the same purpose.

Invariably the operator and other observers should be under cover at a safe distance when the shot is fired.

Where metal breaking work is more or less continuous, or a matter of constant routine, it is strongly recommended that a special pit, lined with sheet metal and with heavy metal roofing, be utilised for shot firing operations. Pits of this construction have proved very successful for the purpose at various iron and steel works throughout the country.

"Ballsok" Bead Insulation.

There are numerous wiring details in connection with electrical apparatus where bead insulation of otherwise bare conductors can be employed to advantage. This applies more particularly to internal connections of auto-transformers, switchgear and starting resistances. For this work it has been customary to cover such conductors with glass beads, but a difficulty arose at elbows and bends owing to the gap between each bead exposing the bare wire. The glass bead is also unsatisfactory in that it is incapable of withstanding the high temperatures immediately adjacent to a resistance element itself. The problem presented has been one of completely insulating the wire throughout its length with beads which



"BALLSOK" BEAD INSULATION.

would resist a high temperature and would entirely cover the conductor, whether straight, slightly curved, or bent at a sharp angle. The accompanying illustration shows an ingenious device for this purpose, described as "Ballsok" beads, which have been introduced by Mr. Lionel Robinson, 3, Staple Inn, Holborn, London, W.C.1, who is the sole representative of the makers in this country.

It will be seen that the well-known principle of the ball-and-socket has been applied to the solution of the problem of bare-wire insulation. Each ball bead accurately fits each socket bead on both sides, thereby assuring unbroken contact between each member, and the complete shielding of the bare wire. One of the features of these beads is that both ball and socket, being reversible, can be threaded without chance of error so long as alternate elements are placed on the conductor to be insulated. Should a surplus ball or socket be threaded on by mistake, either can be cracked off with a hammer. The "Ballsok" beads are fire-resisting, and they are non-hygroscopic. It is also interesting to note that they are accurately moulded to 1-1000th in.

A Fettling Shop Speciality.

It is common knowledge that the fettling-shop is the most neglected shop in the most neglected department in an engineering works, and we are always pleased to note developments in this direction. Quite often the cleaning shop has to use plant designed for other departments, especially in regard to grinding machinery. The machine illustrated below, however, has been designed specially for dressing castings. The manufacturers

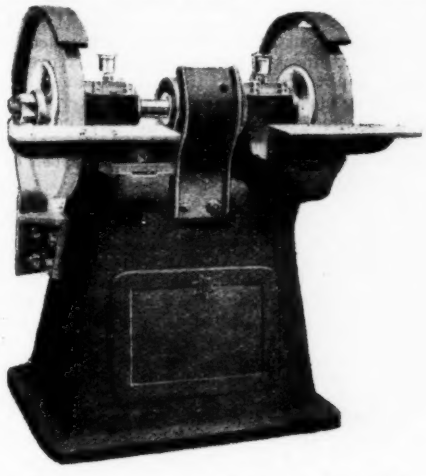


FIG. 1.—A DOUBLE GRINDING MACHINE, SPECIALLY DESIGNED FOR FETTLING SHOPS.

are Messrs. John Warner & Sons, Phœnix Foundry, Hanley. This firm being themselves foundrymen have first-hand knowledge of the duties required. The principal features of this 18-in. double-wheel dry grinder are its sturdy construction and ability to run for long periods without shut-downs for repairs. It takes wheels of 18 in. by 2 in. and 18 in. by 1½ in., but 3-in. wide wheels can be fitted if so desired. It runs at 1,060 revs. per minute, takes up an area of 5 ft. by 4 ft. 6 in., and weighs 8 cwts.

A point worthy of notice is that the size of table allows practically all the weight to be borne by the machine, even though the casting may weigh a hundredweight—a factor not always provided for.

Use of Carbon Dioxide Recorders in Controlling Combustion of Powdered Coal.*

BY D. M. SCOTT, Works Manager, T. H. Symington Co., Rochester, N.Y.

This paper describes the use of carbon dioxide recorders in controlling melting and annealing operations in a malleable cast-iron foundry when powdered coal is used as a fuel. The change from hand firing of air furnaces to powdered coal resulted in a decrease of from 20 per cent. to 50 per cent in the cost of repairs, fuel and labour. While these reductions are most satisfactory, the possibilities of greater economies are apparent from the results obtained with occasional heats run under ideal conditions. The value in determining the carbon dioxide content lies in the fact that it indicates the proportion of air to coal, completeness of combustion and presence of furnace leaks. For furnace or fuel there is a certain mixture of air and fuel that give the best obtainable results. The only accurate guide as to when this correct mixture of air and fuel is being used is by the constant analysis of the fuel gases.

The paper goes into detail regarding investigations undertaken to establish proper furnace and oven practice when using powdered coal. Annealing oven conditions investigated included four distinct types of feeders: horizontal screw, gravity, syphon and vertical screw.

* Abstract of a Paper read before the American Foundrymen's Association.

Melting Steel and Cast Iron together in the Cupola.*

By J. Hogg.

Much experimenting with steel and iron mixings has been carried out by experienced foundrymen, both at home and abroad, and many of them have been extremely successful, chiefly with amounts of steel varying from 10 to 40 per cent.

It has been the practice to refer to cupola melted mixtures of steel and iron as semi-steel. Many ironfounders and engineers have unbounded faith in, and enthusiasm for semi-steel mixtures, for without doubt, such mixtures are extremely useful for certain classes of work. The writer has cast piston rings in large quantities, which have given satisfaction, using a 20 per cent. addition of steel, and has preference for the mixture because of its fine wearing surface.

The writer's first experience in putting steel in the cupola with iron took place about eight or nine years ago. He had to deal with an order for six rollers, about 2 ft. 6 in. dia. with a 12 in. face, and with the order came a request that the castings should be made of a good wearing metal, as those previously supplied were of soft grey-iron and had worn away very rapidly. At the same time the castings had not to be too hard to machine, and had to be dense in character. One of the old hands in the shop advised the putting of a few old files in the ladle and tapping the iron on to them. This method did not appeal to the writer, as he had seen it done in his apprentice days with very indifferent results, and had often heard the method criticised. It was decided to adopt the method recommended by various lecturers at that time and put the steel in the cupola with the iron. Twenty per cent. was charged in small punchings of mild steel, and good rises were made on the castings. The moulds were skin dried, and the results were satisfactory, although the castings were harder than the usual grey-iron mixture, but they machined up very well.

These mixtures have been used very often since that time and have been quite satisfactory.

Steel Turnings Used.

During the latter part of the war, when C.I. shells were being made in large quantities, and a high tensile-test had to be furnished, many foundrymen used steel and iron mixtures, among them was included the writer. Fairly high combined carbon helped to provide a satisfactory tensile test, and the use of steel provided the necessary combined C. without resorting to white iron, which would not be satisfactory for machining purposes. It also helped to provide a good sound casting. On a charge of 10 cwts., 5 cwts. of good scrap was used, 3½ cwts. of pig iron of two brands which were considered suitable, and 1½ cwts. of steel. Owing to the great amount of steel required each day, punchings could not be obtained, so steel shavings from the shell turning department were substituted, the method proved successful. The shells were clean, dense and machineable, the tensile test which was taken from the body of a shell, chosen by the inspector, varied from 12.1 to 14 tons. After a few days' continuous progress, a difficulty arose. The castings began to harden up, and this was soon traced to the re-melt among the scrap, which was used at the proportion of 20 per cent. Reference is made, of course, to runner heads, risers, and gates. It was necessary to reduce the steel to 1 cwt. per charge for a few days, and this method helped us to soften the castings a little, without affecting greatly the density or the tensile result. The hardness and tensile strength were tested daily, in the morning, and the proportion of steel varied accordingly.

One test gave the following result :—The analysis of one test, which gave tensile 13 tons and machined easily, was Gr.C., 2.70; C.C., 0.65; Si., 1.8; S., 0.11; Mn., 0.34; and P., 0.59 per cent.

It was thought that the Mn. ought to be higher, perhaps double the quantity, and eventually a brand of pig iron was chosen that was thought would give a reasonable amount, but after ordering it the firm was unable to obtain delivery at that period, so no change could be made.

The writer often uses steel now in amounts of 15 per cent., and it is fairly satisfactory, and always so if the metal is poured hot. Small pieces of plate or cuttings of mild steel bars seem to be best for the purpose.

Practical Details.

A good bed of coke is used of good quality. The pig-iron is placed on the coke and limestone, then the steel, and last of all the scrap. No receiver is attached, but effort is made to get the charge melted completely before tapping into the ladle, because it is presumed that the charge must be well mixed.

A very high temperature is favoured, as the metal had to be very hot when poured, because of the danger of hard spots. If the mould is a green sand one it is best to have it on the dry side if possible. A dry sand mould would be better still for the purpose. If the metal is at all "dull," blow-holes are almost certain to appear when machining the castings, or if the metal is not well mixed, or the mould damp, hard places will appear, causing the casting to be rejected. It is advisable to have the metal analysed at intervals, or at least to test for combined carbon, which must not get above 0.85 per cent., if the castings require machining.

A Simple Hardness Test.

A test the writer has had strongly recommended to him for testing the percentage of combined carbon is to polish a small sample of the iron and then boil it for a few moments in sodium picrate. The combined carbon will assume a rich brown colour, and there is not much difficulty in judging its amount from day to day. This is a special test for hardness, and can be carried out by means of a low power microscope.

Applicability of Semi-steel.

Steel additions are also useful for getting a good transverse strength, and it is particularly applicable for beams, girders, pipes which may have to hang over a large span, without much support and even light section castings which do not require much machining, such as levers for valve work. Ten per cent. of steel added to 40 per cent. pig and 50 per cent. good scrap will give good results if mixed properly and melted at a fairly high temperature. Common iron with steel added are often made to fill the place of higher-priced irons. Personally the writer would not eliminate the better class iron entirely, but reduce the quantity, say, from 20 to 10 per cent., or in such proportion as may be considered necessary. Of course, these mixtures will not take the place of steel itself. It has been found that firms which were having castings made in steel, and after hearing of the so-called semi-steel, decided to change over to this product because of the price. They have made the mistake of expecting semi-steel to replace steel, but needless to say it will not do that. For improving grey cast iron it is eminently suitable when used with discretion.

Order of Charging.

In a jobbing foundry where different mixings of metal are required, and some of them are to be steel mixtures, it is suggested that about two tons of grey cast-iron be melted first, so that the cupola may have a change of becoming heated to a high temperature before starting to charge the iron and steel mixtures. An extra layer of coke may be placed above the last grey-iron charge, so that the grey-iron charge may have time to be removed before the steel mixtures begins to melt and fall into the bottom of the cupola. The lighter cast scrap will, of course, be put on the last of each charge.

The coke should not be used too sparingly with an iron and steel mixture. Of course, it is not meant that it should be wasted, but sufficient

* A paper read before the Lancashire Branch (Burnley Section) the Institution of British Foundrymen.

should be used to ensure hot melting. If possible the metal should come down the spout bright white in appearance, or even dazzling white, if it has any distance to be carried. The writer would say that he has found Pouilett's table, published in Professor Rhead's book on iron founding, a useful method of judging the temperature of molten metal without a pyrometer.

An excess of limestone should be guarded against, as owing to the high temperature used in the cupola it may result in destroying the cupola lining and the face of the bricks.

The lecturer hopes the remarks made are as plain and as practical as he had hoped they would be. Perhaps more details about the structure of the mixtures might have been given and also of the method of melting the steel, and of the steel taking up its carbon from the coke, etc., before becoming fusible, but he felt that first of all interest must be aroused, and then one would be able to take up the study of the subject more deeply afterwards.

He is not prepared to recommend the addition of steel to the metal in the ladles, because of one vital point. It lowers the temperature of the metal in the ladle, and this is vital. A foundry foreman had better not use steel at all and keep to his grey iron mixtures rather than attempt to cast steel mixtures at a low temperature. Keep to high temperatures if success is to be obtained, and also remember that the following rule applies:—

Softness to hardness.
Weakness to strength (Tensile).

For transverse strength aim at a lower total carbon with just sufficient Si to keep the combined C. below 0.75 per cent.; if this proportion is increased machining difficulties will arise.

If steel turnings are to be used, it can be done successfully if one charges by weight and sees that the light shavings of steel are kept from blowing up the cupola chimney.

DISCUSSION.

Semi-Steel Firebars.

MR. COOPER asked whether more coke was required for melting the mixture of steel and cast iron than was usual in ordinary foundry practice. Was that an item of extra cost to be taken into consideration? Was the mixture suitable for heat-resisting castings, such as annealing pots, furnace frames or firebars? Was it worth while to put steel into castings of that description in order to get a superior firebar which would last longer? Could not the quantity of Scotch iron be reduced by substituting No. 1 for No. 3, and would the difference in price be justified?

MR. HOGG replied that extra coke would certainly be required. He had heard it claimed that textile castings could be produced using 1½ cwt. of coke to the ton, but he had not been able to do that satisfactorily himself. He thought it would take 2½ cwt. per ton to melt iron and steel effectively. A lesser quantity might suffice, but he had seen iron coming down perfectly melted, but with very thin steel shavings imbedded in it, and that was due, he thought, to an insufficient quantity of coke. Before steel could be melted it had to take up a certain quantity of carbon, and it took that up from the coke and the iron in the cupola. If there was not enough coke it did not get the requisite amount of carbon and would not melt.

A mixture of steel and iron he should consider ideal for firebars, because they would have a longer life than the ordinary soft grey iron bars. He had himself cast quite a number.

No. 1 or No. 3 Pig?

He hesitated to say whether there would be economy in substituting No. 1 for No. 3 Scotch iron; it depended on the price. With a reduction of 14 lbs. the same chemical analysis would be obtained associated with the same result.

MR. COOPER: In my opinion it is more economical to buy No. 1 Scotch than No. 3, not for semi-steel alone, but at all times.

MR. MILES pointed out that when starting with No. 1 they commenced with a low percentage of combined carbon. What would Mr. Hogg do with scrap that was left over?

MR. HOGG stated that he would use it for bars and for heavier work such as brackets and pillars. He would mix with it a small percentage of ordinary common iron. It would be satisfactory when it was not intended to machine the casting.

MR. MILES remarked that very good results were obtained for light machinery castings, with the following mixing: Semi-steel shell scrap, 50 per cent.; 4½ per cent. silicon pig-iron, 20 per cent.; ordinary shop scrap, 30 per cent. But care must be taken that the shop scrap did not unduly increase the amount of combined carbon.

Size of Heads.

MR. LAYFIELD asked whether it was necessary to have a bigger head with a semi-steel casting than with an ordinary grey iron casting.

MR. HOGG replied that if a casting was required to be very dense, it should be furnished with a good head. He would not say that with semi-steel a bigger head was required than with soft grey iron, but he would certainly advise putting a good riser and a good head.

Temperature Considerations.

Mr. Hogg gave the following figures (degrees Centigrade) as showing the appearance of liquid iron: Deep orange, 1,100; clear, 1,200; white, 1,300; bright white, 1,400; dazzling white, 1,500.

MR. HOGG, replying to Mr. Barnes, said the colour was due to the very high temperature. By putting on a large quantity of coke for a small percentage of iron they would get the metal melted dazzlingly white. He did not advocate pouring into the mould dazzling white, but by the time it got to the mould the temperature would have fallen somewhat.

MR. BARNES suggested that dazzling white when poured into the mould would result in a sand-burnt casting.

MR. HOGG agreed, but said the sand should be on the dry side. For a heavy casting the sand should be at least skin-dried. Sand does not penetrate deep into the casting. It would be pitted about the face of the casting. For instance, if a flat plate ½ in. thick is cast, there would be seams all over on both sides, top and bottom. If the sand found its way into the metal it would make dirty castings. Semi-steel was not suitable for ornamental work which did not require any strength. For work of that class he would use the commonest high-phosphorus iron.

MR. MILES said he thought it had not been made quite clear about the use of scrap. It had been proved when using a mixture of 40 per cent. steel that all the returns could not be used. In one foundry where 35 tons per day were melted, including risers and runners, 12 tons out of the 35 had to be re-melted. After several days it was found to be impossible to use that 12 tons with the 40 per cent. steel, so that it was cut down to 10 per cent. in order to enable all the returns to be used each day.

MR. HOGG said he used exactly the same mixture. If at the same time he had had orders for ordinary work he could have got rid of the returns. He did not advocate using a high percentage of steel with a high-phosphorus iron.

MR. MILES: I should say it was satisfactory if the percentage of phosphorus was not above 1.2 per cent. It is being used extensively with pig-iron containing 4 to 5 per cent. silicon.

MR. HOGG, answering Mr. Barnes, said he thought a ratio of 1½ tons of coke to the ton of iron could be used with a cupola 2 ft. 8 in. dia. melting 10 tons a day. He had himself often melted with 2 cwt. His full blow was 10 or 11 tons, but it depended upon the nature of the work. With very light casting the iron could not be melted satisfactorily with 1½ cwt. to the ton.

MR. BARNES, referring to a blow of 5 to 6 tons a day, said that before the war his cupola used to average 2½ to 3 cwt. of coke to a ton of metal, exclusive of bed, but now it has risen to 4 cwt.

MR. COOPER said his work was fairly heavy work, and he used 3¾ cwt. to the ton.

Contraction of Semi-Steel.

Replying to a question as to the effect upon the allowance for contraction, Mr. Hogg said that depended upon the type of casting. With a long pipe, 9 to 10 ft. long, where the combined carbon was very high, there would be a considerable contraction, but in the case of a square or round block

with a semi-steel mixture there was no need to make any difference in the allowance for contraction.

MR. BEECROFT suggested that the amount of carbon would be the same whatever the shape.

MR. HOGG explained that the total amount of carbon would be the same, but because of the difference in the rate of cooling the proportion of combined carbon would vary. It was difficult to speak dogmatically on these points, for in some cases the contraction might be greater than in other cases. Differences occurred even when the same mixture was used.

MR. HARWOOD, speaking on behalf of the engineering students, said the lecture had been exceedingly instructive. In the past the foundry side of the industry had been neglected in technical schools, and he was glad that in Burnley, which they were disposed to regard as a pioneer town, steps had been taken to encourage the education of foundrymen. At all times it was a pleasure to meet a practical man who understood his trade and could explain it, and more could be learned from him than from a purely academic man. The College had a good 25-ton testing machine, and if the engineering department could render assistance in regard to any phase of the craft they would be very pleased to give it. They felt that the foundry people could also teach them something.

THE CHAIRMAN (Mr. R. Place) said during the war his firm, like most of the others in the town, were engaged upon munitions, and it was absolutely essential for them to experiment with the use of mild steel. Before the war they used to introduce a little hematite into the mixture when the tests of tensile strength were low. The castings were very light. During the munitions period they were not allowed to use hematite for that purpose; therefore they had recourse to mild steel. He regretted that they did not keep records of their experiences, because they would now have been very interesting, but at the time all their energy was given to getting out the work. In the past there had been a lot of secrecy among foundrymen, but the wiser policy was to make known anything that would help the trade as a whole. In that way they would bring back prosperity to the country.

A vote of thanks was accorded to Mr. Hogg, on the motion of MR. PELL, seconded by MR. MILES.

Simplifying Cores for Water-Cooled Journal Box.

MR. M. E. DUGGAN, writing in a recent issue of the "Iron Age," after emphasising the necessity for co-operation between the foundry and pattern-shop, sets out as an instance the case of a water-cooled journal box here illustrated, which, until

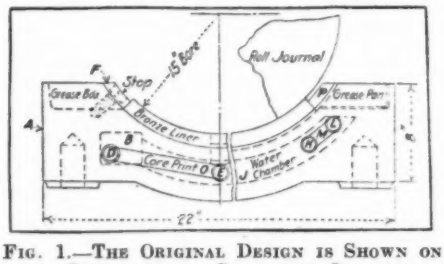


FIG. 1.—THE ORIGINAL DESIGN IS SHOWN ON THE LEFT AND THE SIMPLIFIED ONE ON THE RIGHT.

simplified by the pattern maker, was an expensive experiment.

The original design is shown in Fig. 1. *A* is the casting, *B* is the cored water chamber with a square section as shown, and *D* a ¾-in. cored hole leading into the water chamber from both sides. It was intended that these four ¾-in. cores (two also in the other half of the casting) would support the body core and provide a means of getting the gas away. This they failed to do, and in addition it was practically impossible to clean out the core sand or to remove the core rods, which caused the moulder to suggest that two more cored holes, as shown at *E*, be added to the casting, and that the core print *O* would assist in getting the gases away besides supporting the core in the mould. While this was true enough, these additional holes weakened the casting so that it broke in service.

The pattern maker then designed the core, as shown in the right. The water chamber J is a plain segment of a circle with a larger cooling surface close to the liner, the cored holes (*K* and *L*) are 1½ in. in diameter (instead of ⅞ in. as before) located near the ends of the cored chamber in the strong section of the casting, and the connecting prints *M* located near the ends and at both sides provide a means of getting the gas out, and are a further support for the body core. The stop *F* is also simplified by making it an integral part of the casting, as at *P*, and a removable grease pan is substituted for the grease box.

Book Review.

STEEL THERMAL TREATMENT, by John W. Urquhart. Published by Messrs. Crosby Lockwood & Son, 7, Stationers' Hall Court, Ludgate Hill, London, E.C. Price 35s. net.

In opening this book one cannot help wondering why Chapter I. is entitled "Recent Developments," we feel sure that "Historical" would be nearer the mark, but a deeper consideration of the 70 or more sub-titles certainly does make the choice of heading difficult. The following is a short selection:—The Carbon Group, Burnt Steel, Case Hardening, Cementite, Recalescence, Effect of Excess Heat, Visualising the Heat, Manganese, The Quenching Temperature, Fatigue Effects, Molybdenum Steels. On the whole we do not care for the classification adopted. For instance, "Annealing" has a short defining paragraph in Chapter I., and in Chapter II., entitled Physical Characteristics of Steel, there appears another eighteen-line paragraph, which tells us that "high speed bars are packed with charcoal in tubes, the ends of which are sealed with fire-clay. These are then heated slowly to 1,500 deg. F. (815 deg. C.) and allowed to remain so for about ten hours until about 1,000 deg. F. (535 deg. C.) is reached. This completes the process." We should have thought this was a case-hardening process. Though it is not at all clear what the author means to convey, we feel confident that any interpretation would not give a bar which would be acceptable to the twist drill or milling cutter manufacturing departments. In Chapter III. annealing is again defined. We would suggest that in future editions the centigrade scale of heat measurement be used, as heat treatment is an essentially scientific process, and the bulk of the readers of this book will, in our mind, visualise temperatures by this scale.

Apart from the general arrangement of the book, which does not appeal to us, and several other minor details, we commend the book to the Sheffield tool steel manufacturers, as it contains much of interest for them. They will be pleased to read that iron ores have a profound influence on the properties of the resulting steel. Whilst we do not dispute this, we are always looking for an explanation.

We would point out in the contents list of Chapter XI.—Tools and their Steels—there appears a sub-heading Nickel-Chrome Steels and their Treatment, we rather looked for an innovation, perhaps learning that some combination of iron-nickel-chromium and carbon had been found, suitable for the manufacture of tools. However, no such section actually exists in this chapter.

The book, by the way, contains some 340 pages and is divided into 14 chapters, the last of which is devoted to stainless steel, which is perhaps the most informative section of the book. It is well illustrated with some 136 pictures and diagrams, and should be appreciated by engineers and metallurgists, as it traverses ground common to the two professions.

Views on Mr. Smalley's Paper on High Tenacity Brasses.

Introducing the Paper, Mr. Smalley said his object in choosing the subject was to present to them the possibilities and to discuss and deal with the pitfalls encountered in the manufacture of high tenacity brass, or, as it was commonly termed, manganese bronze. The Paper then treated of the manufacture of pure brass, its physical properties and constitution, and then dealt with a third element, aluminium, going on to tin and manganese, and so forth. The effect of a fourth element was then considered, and had been thoroughly investigated, and then they went on to a fifth element. They would realise that to explore these fields exhaustively one would require a good many papers, and he merely presented to them a general outline of the procedure adopted by their foundries in overcoming the problem of high tenacity brasses, in order to put the manufacturer on a sounder basis and to understand the true functions of the elements introduced. He thought most of them would agree that in high tenacity brasses the number of constituents introduced was so high that they were almost bewildered by the complexity, and hence manganese bronze had got a bad name. This, he was afraid, was largely due to many inventors having appeared to gather as many elements as possible in an alloy. This, then, was really the object of bringing before them this partly synthetic examination of high tenacity brass and bronze. In the second portion he dealt with practical problems of manufacture. Some objection might be put forward that he had only dealt with chilled castings for tests, and they might say that these did not represent sound castings or casting tests. While that was practically true, they must at the same time bear in mind that his investigations in the first place were to find out the effect of the elements introduced, and that could only be done by having a constant area of solidification, and knowing the casting temperature. Had he adopted a sand casting, it would have been impossible to do that.

Lead Content of Brass.

Mr. V. C. Faulkner mentioned that he had recently met a very important representative of an American firm which manufactured a certain amount of non-ferrous material in this country, and he was told that they were buying brass from the States and France, especially light material, because it had a higher lead content than English material, and the latter did not machine up so easily. It seemed almost necessary that lead would have to be introduced in larger quantities for small repetition jobs. Mr. Smalley had said that manganese bronze had a very bad name, but he thought that statement needed some qualification. He believed that it had already established itself as a very excellent material within limits for propellers.

Casting Temperature.

Dr. P. Longmuir said the Paper was one of keen interest to the brassfounder, and he would especially emphasise the author's remarks in presenting the diagram of the constitution of Cu-Zn. alloys (Fig. 1). All high tenacity brasses or bronzes were based on round about 60 copper and 40 zinc, extra strength being secured by small additions to something within that composition. He did not know whether the author had experimented at all on a varying zinc content. Experience had shown that approximately 60/40 was the best; but in practice, especially with air furnace melting, zinc losses did occur. Many years ago they were up against this problem of always having in manganese bronze a constant zinc, and they took lessons from Siemens steel furnaces by sampling their air furnace charges, and, according to the result of the sample, making up any deficiency in zinc. If the zinc kept constant, then constant tensiles ensued, provided the casting temperature was watched. He could hardly agree in fixing a definite 10 per cent.; super-heated casting temperature must vary with the section of the casting. He congratulated Mr. Smalley on his Paper.

Importance of Manganese Bronze.

Mr. G. C. Pierce (London) said he merely wanted to substantiate what Mr. Faulkner had said about the utility of manganese bronze. He was reminded that something like 200 tons per week were put into castings in London alone, and he mentioned this to show that there was a big field for its use.

Mr. Sperring corroborated this statement so far as the dockyards were concerned. All the propellers and 50 per cent. of the metal melted in the dockyards was manganese bronze.

Important Points Indicated.

The President (Mr. H. L. Reason) thought it would be generally agreed that in the short time they had had to consider this Paper, containing as it did such an abundance of information in connection with high tenacity brass, there was a lot that would require a good deal of further study. Mr. Smalley had made it quite clear, and it was corroborated by Dr. Longmuir, that if they were out to make high tenacity brass it could not be done by the ordinary rule-of-thumb methods of the brassfounder. In making ordinary brass alloy or bronze alloy they had carefully to watch their constituents and their losses, and also watch very closely their pouring temperatures. If one was inclined to think that these alloys could be taken up haphazard and get good results, disappointment was bound to follow. But Mr. Smalley had pointed out quite clearly that if they watched the point he had referred to they ought not to have a great deal of difficulty in obtaining good and regular results. Looking through the totals and the results obtained by different alloys, they would notice that the increased yield point and tensile had invariably been obtained by a loss on the elongation. The increased yield point and tensile, or the figures that Mr. Smalley gave, were of course high, due to the fact that they were chill-cast. They must not expect to get these results in an ordinary sand cast, for, as Mr. Smalley pointed out, in making research of this description and giving reliable results, he was bound to have a fixed rate of cooling, and he must compliment him on the step he was taking in that direction. By having a fixed rate on permanent moulds Mr. Smalley had been able to place before them most reliable data. As an example of what took place by raising the yield point and elongation, if they examined Table 2 (page 12 of the Paper), and compared No. 9 with No. 11—he thought it was No. 9, without referring to the Paper—that No. 11 gave the highest tensile of the 42 alloys that had been dealt with. It would be surprising to those who had not studied the Paper to know that the author had given the result in his Paper of no fewer than 42 distinct alloys. In the one which gave the highest tenacity they found the lowest elongation, 3 per cent.; but in No. 9 there was a considerable drop in the yield point and tensile. But they would notice that for that corresponding drop there was a considerable increase in the elongation, and he thought Mr. Smalley would agree that, generally speaking, for copper alloys, an alloy that would not give them 15 to 25 per cent. elongation was really too hard and brittle for commercial use. The alloys that appealed to him, and should be considered in conjunction with the results in Table 1a, were 70/30, 59/41; for standard commercial alloys he should pass to Table 2 and mark Nos. 11, 9, A2, and A4; and then to Table 5 he should number F2, Table 9 AM4, and Table 10 AM3C and AM3D. Mr. Smalley had confined his attention to what he (the speaker) should term brass. Although he headed his Paper "High Tenacity Brass and Bronze," he hoped they would pardon him for saying that he thought it was distinctly high tenacity brass. He hoped that at some future date the author would have the opportunity of conducting a similar investigation in connection with brasses with a copper content from 85 to 88, and show the effect of tin, zinc, lead, nickel, manganese, aluminium and iron. He could strongly support what Dr. Longmuir had

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said, that this was one of the best Papers given on high tenacity brass, and, as an Institution, they were very much indebted to Mr. Smalley for his investigation, and for giving them the results.

The Author's Reply.

MR. SMALLEY, in reply, agreed with Mr. Faulkner that lead was very necessary in these alloys; but he had not considered lead, because he thought he had gone far enough. However, as far as its effect on the physical properties went, he thought he could say that on ordinary manganese bronze, lead had no appreciable effect up to 0.75 per cent., and they would be safe in using that quantity. If they went beyond that, they would be limited by the test results as to what they required. Mr. Faulkner had perhaps misunderstood him in regard to the usefulness of manganese bronze. He did not wish to imply that it was an unreliable material; what he meant was that he had seen so many papers on manganese bronze with a condemnation of it by various engineers in the past, and it was to this he referred rather than to the position of manganese bronze to-day. Thanking Dr. Longmuir for his kind remarks, Mr. Smalley said, as the Doctor pointed out, absolute precision and control of composition was a first essential in the manufacture of these alloys. He would not do it by the zinc content; he did it preferably by structure, because in having control of the structure they controlled their properties to a more reliable degree. For if they introduced various elements which had high zinc equivalents, then they exercised a much more important effect than zinc. For example, aluminium was six times as efficacious as zinc, silicon ten times, magnesium 2½ to three times, and so forth; and so in a complex alloy they must have precise control of the composition. Mr. Pierce had referred to the important use of manganese bronze, and he (the speaker) confirmed that, and quite agreed it was a very successful material.

Some Notes on Semi-Steel and Loam Moulding.

In connection with Mr. Cameron's Paper on "Semi-Steel," Mr. Thomas Bell wrote that he was very sorry so little time could be allowed for discussion of the very excellent Papers presented to the Conference. He had expected to hear some remarks from some of the practical men regarding the use of semi-steel for the heavy class of castings, and he was anxious to get some information as to its use for same. In the addendum some useful information is given: still, he could have wished for some information as to the method adopted in keeping the metal hot in the ladle when a large quantity is required and can only be drawn off in three or four taps. Another point which is always well discussed is the form of the graphite for high-tensile tests. It would have been of great interest to the practical men to have had some information how to get the graphite in this fine divided form. He supposed casting temperature would have something to do with it. Could this be regulated? He was delighted with Mr. Cameron's Paper, and if he or any of the members who took part in the discussion can offer any further information on these points he, as one of the practical men, would watch THE FOUNDRY TRADE JOURNAL with interest for same.

Regarding Mr. Varlet's Paper on "Loam Moulding," he would like to support in a general way the remarks of Mr. Gallon on the class of apprentice taking up loam moulding, and would ask Mr. Varlet if he has always found the moulding of the marine cylinder with the feet or stools down the best method, as it is very general in Scotland to cast marine cylinders with the feet or stools on top. We are enabled to run from the top by dropping a number of gates straight down the barrel thickness. He had very seldom seen a clean casting run by the gating system shown by Mr. Varlet. Slag invariably gets in by this system, but it is possible the slag may be floated up into dirt head shown. He was afraid very few would risk running a cylinder in the manner shown. He would thank Mr. Varlet for his very interesting "History of Loam Moulding in the Province of Liège."

Concerning Machine Moulding.

By J. J. Atkinson.

The invention of the spinning machine by Richard Arkwright, afterwards Sir Richard Arkwright, is common knowledge to all who are mechanically interested or inclined and to many others, too. How, when 36 years of age, in the year 1768, he erected his first machine at Nottingham and had a hard battle to fight, how his first mill was destroyed at Chorley, how men and masters were hostile to his invention, and how protracted litigation greatly vexed him, and after all, how in the end his triumph was pronounced. This, of course, is history of a century and a half ago, but it is none the less true, in this as in other history that repetition has occurred, as has been seen in the attitude of moulders within recent years to the advent of machines which from the commencement were bound to come into their own.

Nor need it be imagined by present-day moulders that machine moulding is an invention of the last two or three decades; the writer remembers reading a book published by Messrs. Howard, of Bedford, in which a description is given of a machine they made for moulding some of their manufactures at least 50 years ago.

Perhaps in no branch of industry has there been greater reluctance to employ modern machinery than in the foundry, and the fault does not altogether rest with the employees. It is not suggested that foundries should purchase every so-called labour-saving device that is put upon the market, but there are, without doubt, several instances where a little capital expended judiciously would have proved a good investment.

One of the reasons which has operated against the success of the moulding machine is that the whole question has not been thoroughly considered before the actual introduction of the machine. The points to be remembered include the variety of work to be handled and the quantities, as the latter will determine whether an elaborate or first-class moulding machine will be justified or not.

The type of machine, whether hand- or power-operated, should also be very carefully considered, as this is important. For example, with the hand-operated machine, the class of work, the output desired, the type of machine, and the number and type of boxes must be studied in advance, together with the question of whether the working is to be by skilled or semi-skilled labour. It must also be remembered that in very plain work, handled on squeezing machines, so-called semi-skilled labour rapidly becomes unskilled, because the pattern is free from stripping troubles, if carefully made free from undercutting and with a definite though not an extravagant taper.

Similar conditions operate with power machines, as the skilled work is done by the pattern-maker, but it presents additional questions. The machine itself is more costly, added to which there is a compressor plant, if air is decided upon, or an accumulator if hydraulic power is adopted. Either demands pipe-lines and fittings. Additionally, there is the power-plant labour, the power for driving the air-compressor, the cost of lubricating oil, water, and repairs.

One or two hand-machines, however, if not required for some time, can be well-greased and set aside with very little overhead charge, which would be difficult with power machines and plant.

The successful working of moulding machines depends very largely on the enthusiasm displayed by the foreman moulder and patternmaker. Unfortunately, the purchase is sometimes made by the manager without taking his foreman into his confidence, and it is only after he finds his purchase unsatisfactory that he sees his mistake. Such conditions are greatly to be regretted, as the opinions of persons who are so closely connected with the working of any machine are surely worthy of cultivation.

The first cost of such machines is very often an obstacle to the foundrymen, but it should be remembered that these are now high-class precision tools. They require to be taken the same care of as machinery in a production engineering shop, and not as shovels and riddles, which in the foundry are usually very badly handled.

Prof. Touceda's Paper on Malleable Iron Discussed.

DR. P. LONGMUIR welcomed the author of the Paper on behalf of the Institution, and congratulated him on the very complete records that he had given of American foundry practice.

American Malleable Iron Practice.

MR. F. J. COOK (Birmingham) added his testimony, having just returned from the States, as to the high efficiency of the malleable products of that tremendous country. He must say, however, that his experience with regard to grey iron was most disappointing. Still, the pleasure and interest it gave him to see what the malleable industry was doing more than compensated for any loss in other directions, and the improvement of the malleable iron industry was mainly attributable to the work of Professor Touceda.

MR. O. STUBBS (Manchester) thoroughly agreed with what Mr. Cook had said. Production in the States was enormous. He had the privilege of going over the biggest malleable iron foundries in America, and the first he went through had a weekly production of 2,000 tons. They were very much in front of British foundrymen as regards malleable iron. The question of interior transport was also a matter of first consideration out there. They did not find a workman wheeling a barrow; everything was done mechanically, and this principle was carried right through. There was no doubt that the Americans were producing a very fine malleable casting. He had the pleasure of meeting Professor Touceda in New York, and he could assure him that they all felt very much honoured by having the opportunity of welcoming him now in person. Indeed, he might say that they had with them that day the highest brains in the malleable iron industry.

MR. S. FLAGG (America), as a member of the Association of which Professor Touceda directed the technical side, said he could not refrain from giving evidence of the high value they put upon Professor Touceda's services. Those familiar with recent published tests of elongation would be interested in his work in this respect. Early in 1914 he saw tests in this country giving 17 per cent., but in work done under the Professor's direction 17 per cent. was considered very low. They would see in his Paper 25 to 30 per cent. elongation as an actual accomplishment under his direction.

PROF. TURNER (Birmingham) joined in welcoming Prof. Touceda, and said it had been his pleasure for the last seven or eight years to read Papers, particularly in the Journal of the American Foundrymen's Association, contributed by him. No doubt this succession of Papers had contributed very largely to their knowledge, and Prof. Touceda, by these published results of investigations, had been instrumental in greatly improving the quality and uniformity of the product in the United States. He did not now propose to discuss the technical matters embodied in his Paper, but he might say he had been struck by the fact that he referred particularly not only to the lay-out of the plant, but to the heating of the foundry, the comfort of the workmen, and the lighting conditions. These were matters which did not receive the proper amount of attention very often in this country. If they were to get the best work out of the men they must be able to work under conditions which were comfortable, and to see properly what they were doing. Part of the Paper, which he had not heard before, touched on a matter relating to the effect of chromium. This raised an extremely interesting theoretical and practical question. There were many pig-irons that contained small quantities of chromium and of nickel, especially those melted from Cuban ores and other ores from the States.

Scientific Gating Advocated.

MR. RETALLACK (Willenhall), speaking of the means of transport in American foundries, said the way they handled material up to 60 and 70 ton loads was remarkable. He also urged the adoption of a policy of scientific gating, relative gating according to the section and size of the casting.

MR. MILLER inquired if Prof. Touceda had considered the use of English irons with regard to making black heart castings. A good deal of work was done there in the making of cycle fittings, which in this country were brazed.

MR. WILKINSON (York) said some of the results obtained by Prof. Touceda were an eye-opener as to the possibilities of malleable iron. Nothing approaching them had come under his notice before in regard to elongation. Alluding to pages 48 and 49 of the Paper, as to the elasticity of castings (headed "Composition Limits"), he said that, having made many thousands of these castings, he must admit that the practice in America differed considerably from the practice here.

MR. J. E. FLETCHER (Dudley) described the Paper as wonderful in its information and scope. The diagram of a melting furnace (Fig. 3) on page 22 of the Paper reminded him of the practice in America of melting heavy masses of metal for malleable cast iron. He thought they were often forgetful of the fact that their American friends were able to follow that practice because of their tremendous output, and these methods placed them in this country at once in quite a different position from the States. Looking at the details of the furnace shown in the diagram, they would see that here the flame effect was able to carry out its purpose efficiently; whereas in their British foundries, even though making black heart malleable, their output was so small that they had to use shorter furnaces, and could not obtain that efficiency of melting that undoubtedly was possible in America. He considered that they ought to be specially grateful to Prof. Touceda for pointing out these phases of malleable iron manufacture. Here they were confined to small crucibles or cupolas, or in some cases small gas melting furnaces; but they were on entirely different lines from those used in America. He assumed that Prof. Touceda would tell them that during the process of melting in these large furnaces a considerable amount of oxidisation took place, which helped towards refining it; it assisted in getting a low carbon metal. Another point which might be noticed by practical men was the position of the running spout in the air furnace. Those who had used furnaces knew how vital this point was, and how serious was the mistake of putting the spout in the wrong position. Emphasising the difference in output of American and British foundries, Mr. Fletcher said that as long as they had small furnaces it was going to be very difficult indeed for them to obtain those high elongations which Prof. Touceda had mentioned. But those interested in the advancement of research and scientific means of working with malleable iron were greatly indebted to him.

CONCRETE FLOORS IN FOUNDRIES.—Judging from the evidence of men who have used concrete floors in foundries for years the question of whether the surface of the floor will spall when molten metal is spilled upon it is not serious. It would be well, however, to avoid the use of granite or quartz gravel aggregates in the construction of such floors, because those materials do not stand heat as well as certain other aggregates. Trap rock possibly makes the best aggregate for resisting heat, and slag, limestone, or limestone gravel may be used with excellent results.—"Brass World."

Employment in July.—The Ministry of Labour report that employment during July showed a slight improvement as compared with June. The percentage unemployed among members of trade unions from which returns are received was 14.6 at the end of July, as compared with 15.7 at the end of June, and 16.7 at the end of July, 1921. The percentage unemployed among workpeople insured under the Unemployment Insurance Act was 12.3 at July 24 as compared with 12.7 at June 26. The total number of workpeople registered at the Employment Exchanges as unemployed at July 31 was approximately 1,400,000, of whom 1,151,000 were men and 170,000 were women, the remainder being boys and girls. At the end of June the number on the live register was 1,455,000, of whom 1,206,000 were men and 177,000 were women. The number of vacancies notified by employers to exchanges and unfilled at July 31 was 14,100, of which 2,800 were for men and 9,200 for women, compared with 16,500 at June 26.

XUM

Discussion on Prof. Campion and Mr. Donaldson's Paper on Strength of Cast Iron at Low Temperatures.

Results on Casting.

Mr. Young remarked that if the figures adduced did not agree with their theories it did not so much matter, as the authors had given them these figures showing the result of their work without drawing their conclusions, and left it to them to use what they had discovered. This Paper was just the type the Institution wanted. The greatest compliment he could pay the authors was that he hoped they would go on with it.

Prof. Turner agreed that the Paper contained so much detail that they could scarcely criticise it in a few minutes. It opened up a new field of work, although they had been told others had been working recently in the same direction. They might regard this Paper as filling in a space in the work of Dr. Carpenter in connection with the effect of what he called high temperatures. They had not hitherto had information on cast-iron at those temperatures at which it was used in connection with superheated steam. They did know about the behaviour of cast iron where they had red heat and beyond, for such things as fire bars, etc. But the information contained in this Paper filled in the space and supplied what was required. It would be a matter for thought and consideration as to the explanation of the effect of annealing upon cast iron. They might suppose that castings which had been allowed to remain in sand and to cool in a normal way would have annealed themselves, and that the annealing at so low a temperature as 300 to 400 deg. C. would not make any appreciable difference. Apparently that was not the case, and there was an appreciable difference due to this annealing. All kinds of suggestions might be made as to the reasons for the effect of 300 deg., and so on, because they obtained a somewhat similar effect in connection with some of the carbon steels. There was an absence of theory from the authors, and he thought further consideration would tell them the right theory. But for the time being, as Mr. Young suggested, it was well to accumulate more facts of the kind which the authors had been good enough to place before them.

Shrink Due to Low Temperatures.

Prof. Touceda mentioned that he had conducted a great many experiments to remove shrink, their idea being to make a study of the amount of shrinkage caused by low temperatures.

Dr. Johnson expressed towards the authors of the Paper his great admiration for the careful and scientific manner in which they had carried out their experiments, and he would like to ask whether they intended, in their continuation of the work, to include microscopic work and other kinds of mechanical and physical tests, such as hardness and impact tests. The Institute was fortunate in having such a Paper presented to its members, containing an account of careful scientific research of such high character.

Dr. P. Longmuir, in congratulating the authors upon the excellence of their work, said they were favoured the previous night by a very good description of the original research. That morning they had an example that fitted in with that description given by the Principal of Birmingham University

Mr. Matt. Riddell, invited to wind up the discussion, said he had seen some of the details and the material worked out, and considered the authors had done something really splendid for the information of that meeting. It was something they had been looking forward to for a long time—a piece of real original research. Prof. Campion was a man trained to do research work, and knew more on the subject of cast iron than almost anyone else. He had special facilities for carrying on his work, and also had the necessary practical experience; and if he could be persuaded to continue in this research work he was confident that Prof. Campion would furnish them with valuable information at present unknown. Alluding to the diagrams showing some change at 400 to 500 deg. C., Mr. Riddell said there must be some important factor in operation in the iron at that particular temperature which required investigation.

The Authors' Reply.

Prof. Campion, in reply, thanked the Conference for the kind way in which they had received the Paper, and also acknowledged the contributions made to the discussion. He quite realised that in a few minutes it was practically impossible to discuss such a Paper, because it was very difficult to digest. He trusted that those who had not been able to speak would send written contributions to the General Secretary, and assured the meeting that he and his colleague would be glad to consider them, and also to reply to Dr. Longmuir, if he would do likewise. Mr. Young had referred to other results which confirmed more or less several results they obtained. Prof. Turner raised the question about possible theories. They had given none in the Paper, because they felt they had not done sufficient work to put forward any theory. It was a very complex problem, and showed distinctly different phenomena from that which occurred at high temperature work, such as Dr. Carpenter carried out. It therefore wanted very careful consideration and far more tests and experiments than they had been able to carry out or analyse. In that respect he might also answer Dr. Johnson, for they had already done a very large amount of micro examination, thermo and other mechanical tests. But the Paper was already loaded, and he thought it was unwise to give too much at once. However, another Paper was in course of preparation for another Institution, which would be presented shortly, and he would be glad to forward to Dr. Johnson, or any gentleman present who desired it, a copy of that Paper when it was presented, and have their criticisms on it. Prof. Turner's remarks were interesting, because he did think that the question of recording casting temperatures had a direct bearing on the behaviour of these metals when heated and cooled at these low temperatures. Some preliminary experiments pointed emphatically to the fact that the amount and nature of the gases included in the iron largely affected the results; and this was largely the explanation of some of these metals beginning to contract instead of expanding when heated.

Mr. Donaldson also replied briefly, saying that they had carried out a considerable amount of work in addition to what was published, particularly in relation to the change of strength after heating and cooling, as dealt with on page 12 of the Paper. But they did not want to publish it, because they had not got to the end of their tests on annealing. He might also say, as to continuing on the lines of work undertaken, that they intended to go on testing those irons with the addition of special elements to see what effect those special elements had on cast iron, chromium, and so forth.

Iron and Steel Output in July.

The National Federation of Iron and Steel Manufacturers report that the production of pig-iron in July amounted to 399,100 tons, or nearly 30,000 tons more than in June, but nearly 9,000 tons less than last May. The July output included 111,400 tons of hematite, 147,100 tons of basic, 91,000 tons of foundry, and 21,000 tons of forge pig-iron.

The production of steel ingots and castings amounted to 473,100 tons, a figure only once exceeded since the resumption after the coal stoppage, viz., in March, when production was 549,400 tons.

The average monthly output of pig-iron was 217,600 tons in 1921, 669,500 in 1920 and 855,000 in 1913. The corresponding figures for the output of steel ingots and castings were 302,200 tons, 755,600 tons and 638,600 tons respectively.

MOULDING SAND RESEARCH.—The American Bureau of Mines, which is co-operating in a general research on foundry sands, organised by the American Foundrymen's Association and the National Research Council, is now collecting data on sands for moulds and cores in aluminium-alloy foundry practice. A questionnaire is being sent to aluminium-alloy foundries to obtain data to be used in the preparation of a report.

American Specifications for Semi-Steel Castings.

New tentative specifications for high-test grey iron castings, familiarly known as semi-steel, were adopted by the American Society for Testing Materials, at the Atlantic City Convention. They are as follows:—

1. These specifications cover all classes of grey iron castings which are required to have a high strength, including those generally known as semi-steel castings.

2. The tension test will be made only when specified by the purchaser and at his expense.

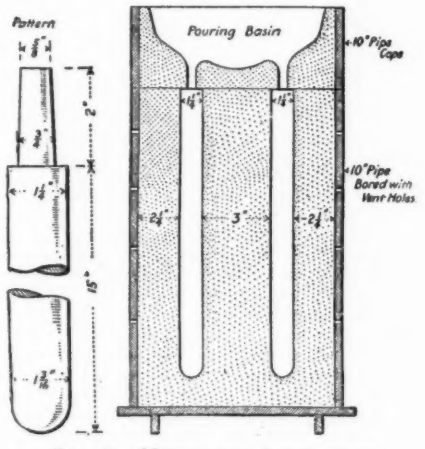


FIG. 1.—MOULD FOR ARBITRATION TEST-BAR.

Manufacture.

3. The castings may be made by the cupola, or any other approved process.

Physical Properties and Tests.

4. (*a*) The transverse test specimens (arbitration test bars) specified in Section 6 (*a*), when placed horizontally upon supports 12 in. apart and tested under a centrally applied load, shall withstand a minimum load of 3,800 lbs. and deflect under this load at least 0.12 in. at the centre.

(*b*) The rate of application of the load shall be such that a central deflection of 0.10 in. is produced in from 20 to 40 sec.

5. When tension tests are specified, the tension test specimen shall show a minimum tensile strength of 28,000 lbs. per sq. in. (12.5 tons).

6. (*a*) *Arbitration Test Bar.*—The form and dimensions of the mould for the arbitration test bar shall be in accordance with Fig. 1. The bottom of the bar shall be 1-16 in. smaller in diameter than the top, to allow for draft and for the strain

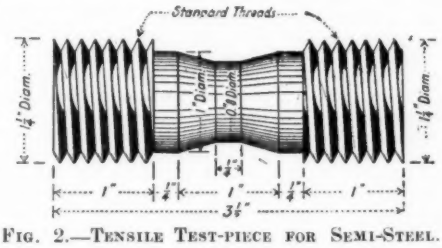


FIG. 2.—TENSILE TEST-PIECE FOR SEMI-STEEL.

of pouring. The pattern shall not be rapped before withdrawing. The flask shall be rammed up with green moulding sand, a little damper than usual, well mixed and put through a No. 8 sieve, with a mixture of 1 to 12 bituminous facing. The mould shall be rammed evenly and fairly hard, thoroughly dried, and not cast until it is cold. The test bar shall not be removed from the mould until cold enough to be handled. It shall not be rumbled or otherwise treated, being simply brushed off before testing.

(*b*) *Tension Test Specimen.*—When tension tests are specified, the tension test specimen shall be turned from any of the broken pieces of the transverse test specimens, and shall conform to the dimensions shown in Fig. 2.

7. (*a*) Two sets of two arbitration test bars each shall be cast from each melt, one set from the first and the other set from the last iron going into the castings. Where the melt exceeds 20 tons, an additional set of two bars shall be cast for each additional 20 tons or fraction thereof. In case of a change of mixture during the melt, one set of two bars shall also be cast for every mixture other than the regular one. Each set of two bars shall be cast in a single mould.

When a large casting is made for which test bars are required, the test bar shall be cast from the same ladle of iron used to pour the casting. If two ladles are used for pouring the casting, the iron for the test bars shall be poured from a ladle of iron caught between the pouring of these two ladles. In either case the test bars shall be poured at as near as possible the same temperature at which the casting is poured.

(*b*) All arbitration test bars shall be tested as specified in Section 4 (*a*).

8. One arbitration test bar of each set cast shall conform to the requirements specified in Section 4 (*a*); otherwise the castings represented by such bars shall be rejected.

Workmanship and Finish.

9. The castings shall be true to pattern and free from gas holes, cracks, flaws and excessive shrinkage. In other respects they shall conform to whatever points may be specially agreed upon between the manufacturer and the purchaser.

Inspection.

10. The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the castings ordered. The manufacturer shall afford the inspector, without charge, all reasonable facilities to satisfy him that the castings are being furnished in accordance with these specifications. All tests and inspection shall be made at the place of manufacture prior to shipment, unless otherwise specified, and shall be so conducted as not to interfere unnecessarily with the operation of the works.

"The Story of Steel."—A six-reel cinema film illustrating the process of steel-making has been produced under the auspices of the U.S. Bureau of Mines and the U.S. Department of Commerce in co-operation with the United States Steel Corporation. It will be used extensively in the United States and abroad for the purpose of showing the many interesting operations employed in the American steel industry. The film will be loaned without cost to all dependable persons desiring to use it for educational purposes. Application should be made to the U.S. Department of Commerce, Washington, D.C.

Luxemburg Iron Industry.—In the course of a not very favourable annual report, the Luxemburg Chamber of Commerce states that although it had been possible in some cases successfully to work the French market, this is now no longer possible in consequence of the raising of the import duties. Belgium offers but few possibilities as a market for the Luxemburg iron industry, while the prices prevailing in Germany, together with the low costs of coke and wages, excluded any prospect of successful business in that country. Under the circumstances, the report states, there is nothing left for the Luxemburg industry but to cultivate overseas markets, as, for instance, Brazil, Argentina, India and Japan; and the sales offices already established in these countries have been further developed. Complaining rather bitterly that Luxemburg industry "has been forced into a subordinate position in the world's markets in relation to those countries who are unfavourably situated financially, and who receive subsidies from wealthy Governments and give orders in return," the report concludes with the remark that as this is out of the power of the Government of Luxemburg, the native industry has to take care of itself in this respect.

XUM

The Analysis of Cupola Slag.

By "Celsian."

Few methods have been given in text-books for the rapid estimation of iron when conducting the analysis of slags.

In the analysis of slags from non-ferrous metals, care is usually taken that the constituents are so separated that more than one can be estimated at a time, thus economising the time expended. This has seldom been attempted when cupola or other iron slags are dealt with. One of the obstacles to rapidity usually encountered is the difficulty in bringing the slags into solution, as many of them require a preliminary fusion with potassium and sodium carbonates and other fluxes.

Rapid methods of dissolving slags in special acid mixtures have been worked out by several chemists, but usually little has been heard of the results obtained. The following method gives details of a rapid means of separating the constituents of the slag after the latter had been dissolved.

Method.

This method may be applied when dealing with cupola, blast-furnace or steel (acid and basic) slags. The powdered sample of slag is weighed out and mixed with a fusion mixture composed of equal parts of sodium and potassium carbonates and about 10 per cent. potassium nitrate. This material is fused in a platinum crucible in muffle furnace, and the fusion when cold is extracted with water and a little hydrochloric acid. As the solution is to be evaporated to dryness, the least possible quantity of water and acid should be used. Where the slag is soluble in acids, it is boiled down to a low bulk with hydrochloric acid and a few drops of nitric acid. Further details of the methods used for dissolving the slag may be had from most text-books on analysis.

To the solution containing the dissolved slag and free silica, add sulphuric acid, evaporate the liquor to dryness and bake the residue on a hot plate. After cooling, add a few drops of sulphuric acid and take up in boiling water, filter, and wash the mixed precipitate of calcium sulphate and silica till free from acid. The addition of alcohol to precipitate completely any remaining traces of calcium sulphate is scarcely necessary when dealing with a concentrated solution. The precipitate is then digested in a hot, strong solution of ammonium sulphate.

Calcium sulphate is soluble in the latter reagent, but the silica is left unaffected. The solution is filtered and washed, and the precipitate ignited and weighed as silica. The best results are secured by filtering the solution hot, and washing first with hot ammonium sulphate solution and then hot water.

A method has been suggested whereby the mixed precipitate of silica and calcium sulphate is first weighed on a tarred paper, after which the latter is washed out with ammonium sulphate and the silica ignited and weighed. By this means the percentage of lime can be obtained by difference, but in some instances the dried calcium sulphate is not rapidly soluble in ammonium sulphate, so that a great deal of time is often wasted.

Lime.

The calcium sulphate is quickly re-precipitated by boiling the solution with a little sulphuric acid and adding about 10 c.c of alcohol before filtering. When little lime is present the solution requires to be settled before filtering: double-ribbed filters should be used. The precipitate is washed with water containing a little alcohol and the mass carefully dried and detached from the paper. After burning off the paper, the precipitate is added to the crucible and carefully ignited and weighed as calcium sulphate, from which the calcium can be calculated. Care must be taken that no reduction takes place at too high a temperature in presence of any unburnt carbon of the paper, as the calcium sulphate may be partly converted to sulphide. The filtrate contains iron, aluminium, magnesium, and small quantities of phosphorus and manganese. The last two and the sulphur are much more rapidly estimated in a separate sample of the slag.

Alumina.

To the filtrate from the lime-silica precipitate, add ammonium chloride and hydrochloric acid, and then neutralise the excess acid with sodium carbonate solution. Add a strong solution of sodium thio-sulphate in such quantity that it reduces all ferric salts to the ferrous state (the solution being rendered colourless). A further addition of thio-sulphate is made, and the solution boiled till free from sulphur dioxide fumes. The hyposulphite is decomposed and aluminium precipitated as hydroxide. Filter the solution, wash with hot water, dry, ignite, and weigh as alumina.

Iron.

To estimate the iron by the sulphide method is the most rapid, but as the remaining filtrate requires to be boiled for some time to free it from sulphide fumes, and a very large, bulky precipitate of sulphur requires to be filtered off, the estimation of magnesia is slower, and more time is required in the long run. The method of measuring the solution, dividing into equal halves, titrating the iron in one portion by dichromate or permanganate, and precipitating magnesium in the other is rapid, but cannot always be relied on to give accurate results.

Another method often adopted consists of oxidising the iron with nitric acid, and precipitating it with ammonia and ammonium chloride, after which the magnesium is precipitated by the usual phosphate method. As the iron has been reduced to the ferrous condition, use should be made of it in this state instead of reducing it, as a great deal of time is lost here unnecessarily.

The following method, although not giving very accurate results with the magnesium estimation, can be relied on to give a rapid approximate assay which is sufficiently accurate for all ordinary works requirements. The solution, after boiling with hydrochloric acid to decompose the excess hyposulphite, is titrated directly with standard potassium dichromate solution and the percentage iron oxide computed.

To the titrated solution, which is still hot, add a few cubic centimetres of strong suphurous acid solution. A green coloration will be formed if the dichromate has been reduced, it should be boiled for a few minutes to effect complete reduction. An excess of ammonium carbonate is then added, and the solution filtered and washed. Ammonium carbonate precipitates chromium and iron, the former as hydroxide and the latter as ferrous carbonate, while magnesium remains in solution, as there is an excess of ammonium chloride present.

Magnesia.

The magnesia is estimated in the usual manner by adding excess of ammonia and ammonium phosphate, stirring, settling, filtering, drying, igniting and weighing as pyrophosphate. Accurate estimations of magnesia are seldom if ever conducted in ordinary works laboratories. To secure the best results the filtrate containing the magnesia should be evaporated to dryness and baked until all fumes of ammonium salts have been evolved. The cooled residue is dissolved in a little hydrochloric acid, treated with a moderate excess of ammonia and the magnesia precipitated with a sodium "hydrogen" phosphate solution after which it is allowed to settle for several hours before filtering.

In comparing the foregoing methods of estimating iron and magnesia with the standard methods, it should be remembered that the latter are not always adopted in works laboratories, modified analysis being generally preferred, which produce results in a shorter time. Any small quantity of the alkalies in the slag is estimated in the filtrate by the usual text-book methods.

Manganese and Phosphorus.

Another sample of the powdered slag is weighed out and mixed with the same fusion mixture as before. Fuse in a platinum crucible, and after cooling dissolve out the mass with distilled water. No acid should be used here unless the mass shows

signs of great insolubility, as it causes part of the silica to separate out. The solution is measured and divided into equal halves, or portions of known volume. To one portion add about an equal volume of concentrated nitric acid and heat to boiling-point. Add a few c.c.'s of a dilute solution of silver nitrate and then several grammes of ammonium persulphate. The nitric acid causes part of the silica to separate out, but it has no detrimental effects on the colour produced by the manganese. The solution is boiled on a water bath until the pink colour is fully developed, cooled rapidly and titrated at once with a standard solution of sodium arsenite until the colour disappears, leaving the solution tinted pale green.

Where little manganese is present, the colorimetric method may be applied, but the solution must not be filtered, as the silica is only incompletely precipitated and not granular, so that there would be a risk of it sticking in the filter. The titration with sodium arsenite is to be preferred to the colorimetric method.

Phosphorus is estimated in the other portion of the solution by applying the colorimetric method, as the ordinary gravimetric and volumetric assays could not be successfully used unless the silica was removed, which would take some considerable time. An excess of ammonium hydrate is added to the solution, together with a little ammonium chloride. The thick iron sludge is re-dissolved in nitric acid, heated to about 70 deg. C., and an excess of a 10 per cent. ammonium-molybdate solution added. After shaking well and warming on the hot plate, the yellowish liquor is transferred to an ore glass and compared with a standard phosphorus solution prepared in a similar manner.

The manganese and phosphorus can thus be estimated without resorting to the prolonged method of separating the silica first. The same procedure requires to be adopted for estimating manganese and phosphorus when dealing with slags soluble in acids, with a few exceptions.

In dealing with slags containing iron in both ferrous and ferric conditions, the ferrous oxide may be estimated in a portion of the liquor from the second fusion, in which cases the fusion mixture used must be free from nitrates or other oxidising material.

Manipulation.

In conducting the foregoing analysis the two fusions are carried out together. The manganese and phosphorus assays are completed while the silica is igniting. The iron is estimated and magnesia precipitated while the alumina and lime precipitates are being dried. The magnesia is settled and filtered while the latter are being ignited and weighed. The magnesia is weighed last. By conducting the analysis in this manner the method will be found to be much more rapid and practically as accurate as the ordinary methods of analysing slags.

THE shipbuilding prospects of the Tyne are rendered slightly more hopeful by the receipt of instructions by Hawthorn, Leslie & Company, Hebburn, to proceed with the construction of two large passenger vessels, which, it is understood, are for the British India Company.

A CONFERENCE of Local Authorities interested in the opposition to the application of the Cumberland Waste-Heat Owners' Company, Limited, to the Electricity Commissioners for a special order in respect of the urban districts of Egremont and Cleator Moor was held at Whitehaven last week. The Authorities represented were the Whitehaven Town Council and Rural District Council, Cleator Moor, Egremont, and Arlecdon and Frizington Urban District Councils. After the matter had been fully discussed, it was resolved that there be joint opposition by the respective Authorities concerned.

FOLLOWING Industrial Court proceedings and an award in relation to the wages of railway shopmen, Sir Henry Fowler, representing the railway companies, has intimated to the trade unions concerned the urgent necessity for the following reductions: 5s. 6d. per week from July 31, 5s. from August 28, and a further 5s. from September 28. Sir Henry has informed the unions that the railway companies claim that the reductions now being put into operation in the engineering industry should operate also in the railway shops. The matter is being referred to the Executives of 28 unions to be dealt with from a national standpoint.

Malleable Castings.

The great improvement in the quality of the malleable iron castings during the past few years is dealt with in a booklet entitled "Certified Malleable in Transportation and Industry," just issued by the American Malleable Castings Association, Cleveland. It is asserted that less than 10 years ago there was little definiteness to the physical properties of the malleable iron and that there were virtually as many varieties as there were foundries making it. Co-operative efforts were started in 1913 by the 25 members of the Association, which has since increased its membership to 50. Through these efforts, it is stated that the manufacture of malleable iron has been changed from a hit-or-miss proposition to a scientific basis.

When the research work was started, with a view of improving the physical properties of malleable iron, members were required to submit test-bars daily. At that time the specifications of the American Society for Testing Materials for malleable iron called for a tensile strength of 17 tons and 5 per cent. elongation in 2 in., but this specification exceeded the product of many foundries. Through individual plant inspection the adoption of more successful practices and the regular submission of test-bars, it was not long before a majority of the malleable foundries were making castings exceeding the A. S. T. M. specifications, and subsequently, at the solicitation of this Association, these specifications were raised to 20 tons tensile strength and 7½ per cent. elongation in 2 in., this specification being later adopted by the Society of Automotive Engineers. The Association was inspired by its success to further improve its products, and as a result a new specification of 22 tons per sq. in. tensile strength and 10 per cent. elongation has been adopted recently. It is pointed out that other desirable properties have shown even greater improvement. Experiments have been conducted to develop soundness, machining qualities and finish. The use of chills has given way to a proper proportioning of gates and risers, so that voids due to unequal cooling of the metal may be eliminated rather than driven to other parts. Sealed castings have been eliminated by the proper selection and treatment of packing materials and the proper protection of casting during annealing.

Role of the Microscope.

The practice of issuing certificates of merit to foundries whose products meet the rigid requirements of the Association, from which developed the term "Certified Malleable Castings," is described, as well as some of the manufacturing processes. The microscope is given credit for accomplishing much in bringing malleable castings to their present high standard of quality. It is stated that one of the most popular fallacies regarding malleable castings was the belief that the valuable properties of the castings is confined to its surface, and that it has a tough outer skin with a hard brittle interior. It is pointed out that a study of the better malleable casting with the use of the microscope revealed that malleability was not due exclusively to the decarbonising effect of the packing material, but rather to the breaking up of the hard carbides and the formation of ferrite or carbonless iron, the most ductile form of the metal, and that this was not confined to the outer layers, but extended to the centre, thus substantiating the theory on which present-day American practice is founded.

Comparisons are made of the physical and mechanical properties of malleable as compared with grey iron and steel castings, drop forgings and compressed steel, and attention is called to the easy machining qualities of malleable iron. Numerous uses of malleable castings are listed, and it is stated that from 200 to 250 lbs. of malleable castings are now used in many of the best types of automobiles for various vital parts.—"Iron Age."

THE JOSEPH DIXON CRUCIBLE COMPANY have removed from 28, Victoria Street, S.W., to 22, Duke Street (Stamford Street), S.E.

XUM

IRON AND STEEL MARKETS.

Pig-iron.

Only slow, if steady, progress can be noted in the recovery of pig-iron markets, but in trade circles a distinctly more hopeful view of the position is entertained, dependent, it must be said, upon some further levelling down of prices in the near future. It is now clearly recognised that revival of demand for pig for home consumption is likely to be a lengthy process, and until a much more active buying interest can be established, any further expansion of business must necessarily be derived from outside sources. The termination of the American miners' strike will probably check inquiries from that country, while most market reports indicate that business with Continental consumers is now comparatively inactive. In South Staffordshire, while demand for foundry iron remains comparatively idle, it is significant that smelters are now regulating furnace practice to produce a larger yield of forge pig due to an improved tonnage required by finished-iron manufacturers. Scotland, having sold fairly heavily to America, is wanting a little more iron, but Tees-side is not getting as much business as it would in normal times and circumstances. Continental inquiries are all for very small parcels, and very little American business has materialised, although there are still plenty of inquiries. It is now reported that one big firm of producers is fixing a minimum of 90s. per ton for No. 3 Cleveland G.M.B. for export. Other makers have not differentiated as between home and export prices, and to do so is certainly to impose an unnecessary handicap on foreign business. Generally, the price of No. 3 Cleveland G.M.B. may be put at 87s. to 87s. 6d. per ton. The scarcity of No. 1 and silicious iron keeps the price at 95s., but quotations for all the lower qualities are irregular, and business is so very quiet that it is somewhat difficult to fix the figure. No. 4 foundry can, however, be bought at 86s. per ton, No. 4 forge is about 84s., and mottled and white is nominally at 80s., with none offered. Shipments disclose a further decline, the total exports from Middlesbrough during August up to and including the 15th inst. being 12,189 tons, compared with 18,087 tons to July 15.

A sale of 2,000 tons of East Coast hematite for prompt shipment to America is reported at Middlesbrough, but apart from this transactions are all for small quantities, and the demand is so restricted that stocks still tend to increase. Competition for orders is very keen indeed, and prices are again easier. The market price of mixed numbers is now no more than 98s., and even that figure might be shaded, whilst for No. 1 the premium is no more than 6d. per ton if any is asked for at all.

Finished Iron.

The increased demand for forge iron implies some revival of activity in the manufacture of finished material, and this is unquestionably confirmed by the resumption of work at several of the mills and forges in the Black Country, many having been idle for months past. The improvement in the outlook, though exceedingly welcome, leaves much still to be desired. The tonnages shown in the Wages Board returns, however, are much below the pre-war level, and there is still quite a lot of plant irregularly employed, or altogether idle. Demand continues inadequate, and experience does not suggest the nearness of approaching pressure. On the whole, the market may be described as remarkably steady, notwithstanding the slight weakness in the price of merchant and commoner bars. This weakness is not general. There are still firms who hold out for the top price, but, of course, it is all a question of quality, and there is such a wide range that this is not so surprising. Marked bars are steady. Rather better business has been done lately in iron angles, and the reports as to gas strips are more encouraging than they have been for some time.

Steel.

Gradually accumulating strength will perhaps best describe the position of the steel trade at the moment. At present, demand is principally confined to the cheaper qualities of steel material, the higher to the cheaper qualities of steel material, the higher grades being still neglected. The withdrawal of the control over prices of sectional steel is, as yet, too recent to adequately estimate its effect upon trade in general, and the market remains somewhat irregular. The restoration of open competition must, however, eventually react to the advantage of both buyer and seller, and should certainly result in an expansion of business in constructional orders in the immediate future. Semi-products are in more active demand, inquiries for billets and sheet bars being in more satisfactory volume than for some time past. At Glasgow, export business in steel is improving much more quickly than the home trade. More inquiries and orders are in the market, and makers are anticipating greater expansion in this branch of the business in the near future. Prices for export show little or no change; in fact, in some cases they are slightly firmer.

Scrap.

With the gradual improvement in trade prospects, movements in the various markets for scrap metals show a somewhat better demand for certain qualities, although buying is still mostly confined to hand-to-mouth quantities. At Middlesborough, the following are nominal prices at the moment :—Heavy steel scrap, 62s. 6d. per ton, delivered works; cast iron borings and steel turnings, 45s. per ton, delivered, although if any substantial parcels were offered the works would no doubt increase this figure; machinery cast-iron scrap in handy pieces, 70s. to 72s. 6d., delivered; ordinary heavy piling scrap, no demand at all, nominal price 60s. to 62s. 6d. per ton, delivered; special heavy selected forge iron, 70s. to 75s. per ton, delivered, according to specification.

Tinplates.

Influenced probably by holiday causes, business in the tinplate market has to some extent tapered off lately, inquiries on overseas account having been below the average, while Continental demands are also reduced in volume. Markets are, however, fairly well booked up with orders extending into September, but there is needed some assurance of continued production beyond that date. Quotations, as far as basis sizes are concerned for prompt parcels, rule at 19s. 6d. and 19s. 4½d. per box, but 19s. 3d. is freely named for October, with a few buyers at 19s. 1½d. To-day's figures may be quoted for coke tins : IC 14 x 20, 112 sheets, 108 lb., 19s. 3d. to 19s. 6d. per box; IC 28 x 20, 112 sheets, 216 lb., 38s. 6d. to 39s. per box, with lights and crosses at usual differences, net cash, f.o.b. Wales.

Metals.

Copper.—Messrs. Henry Bath & Son, Limited, in their fortnightly metal report under date, August 16, state :—More business has lately been done in refined qualities, the demand for which appears to be improving since the supplies of scrap material have become scarcer. The American quotation for electrolytic has practically shown no change during the whole period under review. It is understood that their surplus stocks of scrap material are also on the point of exhaustion. The Metal Exchange returns of the stocks of copper in warehouse on July 31 show : 1,808 tons refined, 11,509 tons rough, and 183 tons unclassified, together 13,500 tons, against 12,922 tons on June 30. Current quotations :—*Cash* : Wednesday, £64 5s.; Thursday, £64; Friday, £63 17s. 6d.; Monday, £63 15s.; Tuesday, £63 10s. *Three Months* : Wednesday, £64 7s. 6d.; Thursday, £64 2s. 6d.; Friday, £64; Monday, £63 17s. 6d.; Tuesday, £63 12s. 6d.

Tin.—A little recovery followed the recent bad break in this market, carrying prices after the holiday to £161 15s. cash, and £162 three months. This advance, however, induced further realising, and, with buyers holding their hands, prices have slipped back about £3 per ton. The tone at the close, however, was quite good, with America showing a little more disposition to buy. To-day the market has advanced about 35s. per ton. The London Metal Exchange gives the United Kingdom consumption for the first six months of this year as 9,842 tons, against 2,822 tons in the same period of 1921. Sales from the East have been on a much lighter scale and the shipments advised so far are small. Current quotations :—*Cash* : Wednesday, £160 12s. 6d.; Thursday, £161 10s.; Friday, £161 12s. 6d.; Monday, £161 2s. 6d.; Tuesday, £160 5s. *Three Months* : Wednesday, £160 15s.; Thursday, £161 12s. 6d.; Friday, £161 12s. 6d.; Monday, £161 5s.; Tuesday, £160 7s. 6d.

Spelter.—This market during the past fortnight has been somewhat erratic, prices fluctuating a good deal, although within fairly narrow limits. Within the past few days there has been a stronger tone in evidence, with a fair amount of good buying by consumers. The general situation is unchanged, and there is no indication of any material increase in supplies. The Metal Exchange returns show a decrease in stocks of 373 tons, the figures being 4,289 tons on July 31, against 4,662 tons on June 30. Current quotations :—*Ordinary* : Wednesday, £31 10s.; Thursday, £31 12s. 6d.; Friday, £31 10s.; Monday, £31 12s. 6d.; Tuesday, £31 5s.

Lead.—After early steadiness prices began gradually to ease off, especially for near delivery. There had been some heavy arrivals, and owing to interference of the holidays, consumers found themselves temporarily fully supplied. A rather firmer tone was noticeable at the close, with a better demand for forward, and indications that the next move may be in an upward direction. The Metal Exchange statistics show stocks on July 31 as 235 tons, against 268 tons on June 30, a decrease for the month of 33 tons. Current quotations :—*Cash* : *Soft foreign* (prompt), Wednesday, £25, Thursday, £25 2s. 6d.; Friday, £25 5s.; Monday, £25 5s.; Tuesday, £25 2s. 6d.

Company News.

John Hetherington & Sons, Limited.—Profit, £154,617; less depreciation, £7,782; debenture interest, £10,000; debenture trustees' fees, £105; leaving a net profit of £136,729; brought in, £79,613; total, £216,342. Further dividend of 15 per cent. actual on ordinary, less tax, making 20 per cent. for year, and a bonus of 2s. per share, tax free; to general reserve, £100,000; carried forward, £61,573.

William Bayliss, Limited.—The directors of William Bayliss, Limited, report that after making all necessary provisions the profit for the year ended June 30 last amounts to £2,108, which must be written off the adverse balance brought forward from last year. This will leave £1,546 to the debit of profit and loss account. The board have exercised an option to purchase the freehold of the works, and the necessary deposit has been paid. A continuance of trade depression has existed throughout the year, and having regard to these abnormal conditions the directors consider the results achieved satisfactory.

Petters, Limited.—After providing for depreciation and bad and doubtful debts, and after transfer from reserve of £25,000 to meet losses on stocks, the accounts show a balance of £10,917, which the directors recommend be carried forward. Directors regret that position does not warrant payment of any dividend at present. Greatly reduced volume of export trade, combined with reduction in demand for agricultural machinery at home owing to drought of last year, has rendered it impossible to secure sufficient business to cover heavy overhead charges. The long continued dispute in the engineering trade in the early part of this year has also adversely affected operations.

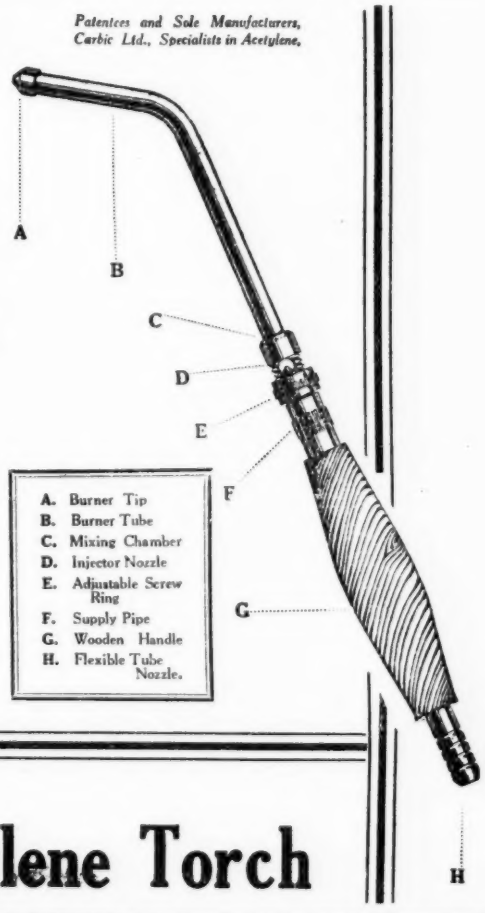
3 useful tools in One

HERE is a new and inexpensive 3-in-1 tool that will quickly save its first cost and thereafter give sheer profit. This is how you use the Carbic Adjustable Acetylene Torch. On a large and costly sand-mould, for example: examine deep awkward corners with the torch set to lighting position; without moving the torch move adjusting ring over the air ports to give a clear hot bunsen flame and "dry" the mould—then set the ring to give a smoky soot-laden flame which rapidly deposits an even layer of finely divided 100% pure carbon. A boy can use this new torch efficiently.

The outfit includes a Portable Acetylene Generator and Hose. Made by the makers of Carbic portable oxy-acetylene cutting and welding plants. Send a postcard for the illustrated and priced folder giving the full description.

CARBIC LIMITED
Specialists in Acetylene,
51, Holborn Viaduct, London, E.C.1.
BRANCHES : Liverpool, Newcastle-on-Tyne, Glasgow, Southampton, Leeds, Cardiff, where stocks are always available.

Patentees and Sole Manufacturers, Carbic Ltd., Specialists in Acetylene,



A. Burner Tip
B. Burner Tube
C. Mixing Chamber
D. Injector Nozzle
E. Adjustable Screw Ring
F. Supply Pipe
G. Wooden Handle
H. Flexible Tube Nozzle.

The CARBIC
Adjustable Acetylene Torch

GANISTER, CUPOLA BLOCKS, FIRE BRICKS, FIRE CLAY.

Silica Bricks, Tuyeres, Stoppers, Nozzles, &c.

STEEL MOULDERS' COMPOSITION, SILICA CEMENT.

J. GRAYSON LOWOOD & Co., Ltd.,
DEEPCAR, nr. SHEFFIELD.

Telegrams: "LOWOOD, DEEPCAR."

Trade Talk.

BOWERS & COMPANY, mechanical engineers, have removed from 37, Joseph Street, to 22, Bolton Street, Bradford.

TWELVE companies of men resumed work last week at the Hodbarrow Iron Mines, which have been practically closed for the last 15 months.

THE small blast furnace at the Level works of the Earl of Dudley, Brierley Hill, Staffs., has been relighted. It was blown out in May, 1921.

THE ironstone quarries at Wartnacy, on the county border of Nottingham, reopen on Monday, and the blast furnaces at Alfreton are also being blown in.

MESSRS. JOSHUA HEAP & COMPANY, LIMITED, Ashton-under-Lyne, closed their works on Friday evening, August 18, and will reopen on Tuesday morning, August 29.

F. W. WOODMAN & COMPANY, 597, Sneinton Hill, Nottingham, are taking over the stock and patterns of the British Engineering & Electrical Company, Leek, Staffs.

THE SHIPBUILDING EMPLOYERS' FEDERATION has decided to negotiate for a further cut of 10s. in wages for all men employed in shipbuilding, with a view to reducing costs so as to secure more work.

MESSRS. SIR W. G. ARMSTRONG, WHITWORTH & COMPANY have received a contract from the Bengal North-Western Railway for 21 locomotives, which will be built at the Scotswood locomotive works.

OWING to the increased demand for boilers, both for marine and land purposes, Messrs. Yarrow & Company, Limited, have decided to reopen the boiler department at their Glasgow shipbuilding and engineering works.

THE Canadian Government Merchant Marine, Limited, is about to start an augmented freight service with the object of encouraging exports of tinplates from South Wales and imports of goods into South Wales from Canada.

AN offer made by Messrs. Lithgows, Limited, of Port Glasgow, to lay down four large cargo-carrying steamers speculatively in order to provide employment for men in their district if the men would accept pre-war rates of wages, plus whatever bonuses they might be entitled to, has been unanimously rejected by the Port Glasgow boilermakers.

THE BOARD OF TRADE has not been convinced that machine-tools imports from countries whose exchanges have collapsed should be charged duties under Part II. (dumping) of the Safeguarding of Industries Act, and it is not at present the intention to appoint a committee under this part of the Act. It is, of course, still open to the applicants to produce further evidence in support of their complaint, but as things stand at present a committee will not be appointed.

RECENTLY the New Zealand Government placed with Messrs. Vickers, Limited, orders for two Pelton turbines and two Francis turbines, each of 3,100 h.p., for the Hora Hora Power Station on the Waikato River. The Pelton machines are now being erected on the site. These machines are designed to operate under a 27-ft. head. This firm recently obtained the orders for the 6,000 k.v.a. generators and the 100,000 volt switchgear for the Mangahao hydro-electric power station in New Zealand.

THE Rotherham magistrates last week adjourned the hearing of six summonses against Sidney Herbert Aizlewood and Frank Else, partners in Aizlewood and Taylor, iron and steel scrap merchants, instituted by the Inland Revenue Department. Prosecuting counsel stated that the firm's accounts had been falsified for nine years, and that the total income-tax, E.P.D. and super-tax missed owing to the action of Taylor, who is now dead, Aizlewood and Else was £18,494. Else is a member of the Sheffield City Council.

THE Executive Council of the Amalgamated Engineering Union have had under consideration the position of the organisation, due to events which accompanied the recent lock-out, and especially the causes which have led to a serious reduction in the membership. It has been decided to invite suggestions from the rank and file with regard to reconstruction, and an endeavour is to be made to get all craftsmen into the society. Owing to the prospective reduction in the wages of engineers, the executive council have decided to restore contributions to normal rates.

IN accordance with the agreement of the Welsh Engineers' and Founders' Conciliation Board, made on May 10 of this year, which governs the wage rates of craftsmen both at Siemens steel works and tinplate works, wages as from August 6 are again reduced by 2s. per week. Smiths' and fitters' wages are now £3 13s. 6d per week. The wage rate at the beginning of May was £4 0s. 6d., and this was reduced by 2s. 6d. per week on May 14, 2s. 6d. on June 11, 2s 6d. on July 9, and 2s. on August 6, making a total reduction since the beginning of May of 9s. 6d. The present wages are to continue until December 31, but a meeting is to be held in November to review the position for January, 1923.

AN AGREEMENT has been reached between the federated steel makers of Sheffield, the District Rolling Proprietors' Association and the Sheffield Forgers and Tilters' on the one part, and seven trade unions on the other part, for reductions of war bonus received by men employed in the heavy steel departments of Sheffield and the rolling mills, forges, and press shops. The effect of the agreement is that the war bonus in rolling mills and forges will be reduced by 2s. 6d. per shift from September 25 next, this cut to be made in three instalments, 10d. on August 14, 10d. on August 28, and 10d. on September 25. The reduction for 47-hour week men employed by members of the Rolling Mills Proprietors' Association and the Sheffield Forgers and Tilters is 16s. 6d., to be made in three cuts of 5s. 6d. on the three dates mentioned. An agreement on similar lines has also been entered into between the federated steel makers and the Iron and Steel Trades Confederation with regard to Siemens melting department, electric furnace, and crucible steel melting departments.

SOME very interesting figures showing the rise and fall in the wages paid by Hadfields, Limited, with the contemporaneous rise and fall in the cost of living, are given in an article contributed by Sir Robert Hadfield to the August number of "Current Opinion," the official organ of the Industrial League and Council. "It was thought at one time," says Sir Robert, "that rapid rates of increase in wages would greatly benefit the worker, but alas! he found that as fast as his wages advanced, so did the cost of living and commodities. I recently had prepared a diagram of my firm's case. During the war we represented a total complement of some 15,000 workers. We have now about half this. I have had this carefully worked out, and find the worker in the years 1915 to 1921 has really lost 18 per cent. as compared with the old rate of wages, the cost of commodities remaining as before. In saying this I do not mean he is in any way to blame for the turmoil which has occurred. Quite the contrary. But in his eager attempt to secure his position, as he has thought, he has only helped to make matters worse, and is not so well off. The above figures are taken from definite data carefully kept by my firm."

Deaths.

DR. GISBERT KAPP, the well-known electrical engineer, has died at his residence at Birmingham. Deceased was formerly professor of electrical engineering in the Birmingham University.

COLONEL R. SAXTON WHITE, who has recently passed away at his residence at Bournemouth, was manager of the Walker Shipyard of Sir W. G. Armstrong, Whitworth & Company from February, 1883, to December, 1888, when he left to take up the managing directorship of the shipbuilding department of the Fairfield Shipbuilding & Engineering Company, Glasgow, which post he resigned about 1895, and returned to the Walker Shipyard as assistant to the late Colonel Henry Frederick Swan, in February, 1896, where he remained until December 22, 1920, when he retired.

Personal.

THE LATE Dr. John Theodore Merz, Ph.D., LL.D., D.C.L., of Newcastle-on-Tyne, left £18,980.

THE LATE Right Hon. Thomas Burt, P.C., D.C.L., of Burdon Terrace, Newcastle-on-Tyne, left £5,128.

THE LATE Mr. William Blow Collis, J.P., of Swinford House, Stourbridge, consulting engineer, left £20,517.

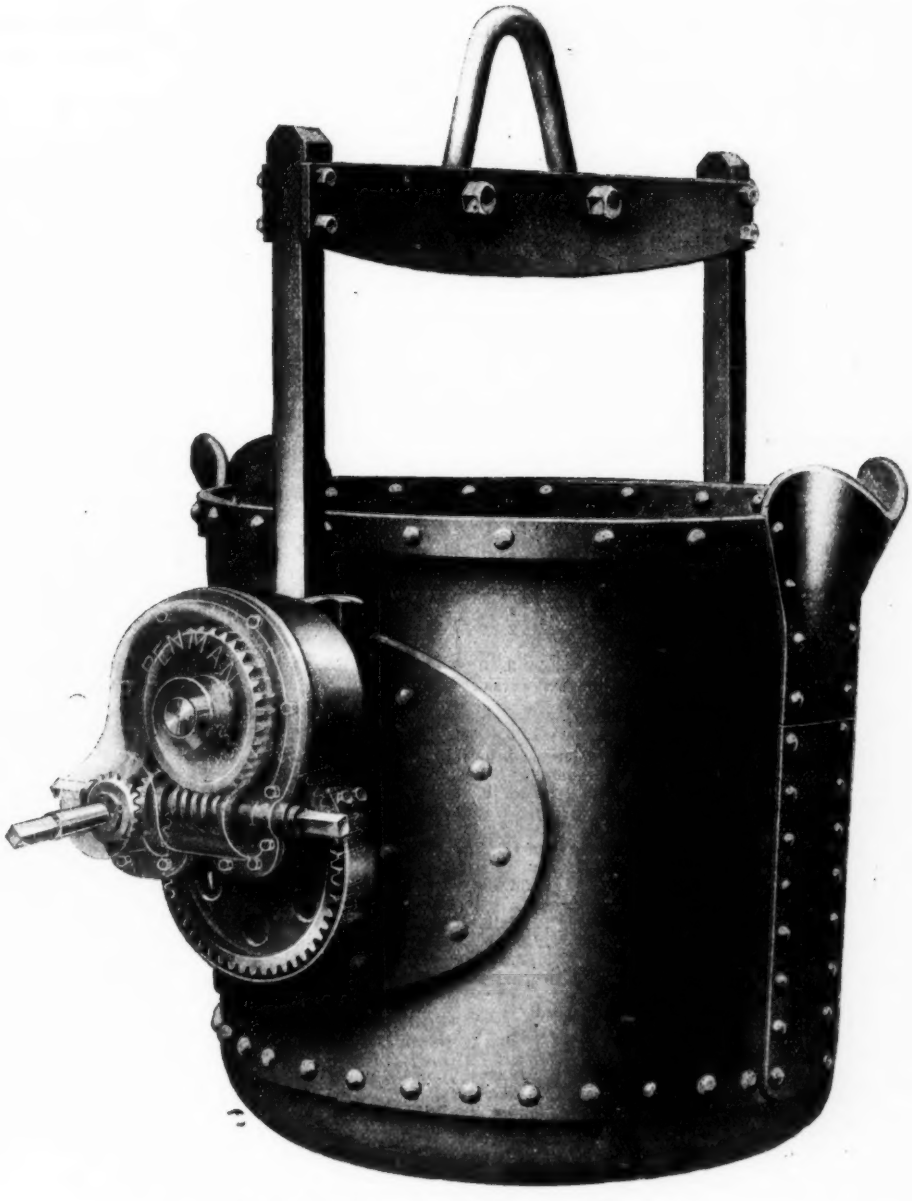
THE LATE Mr. John Thomas Middleham, secretary and director of Hadfields, Limited, Sheffield, left £28,380.

MR. S. WILLIAMSON, the late general manager and secretary of the Cambrian Railways Company, has joined the directorate of the Welsh Town Planning and Housing Trust, and has been appointed deputy chairman.

MR. ROBERT HOBSON, President of the Steel Company of Canada, Limited, of Hamilton, Ontario, is at present on a visit to England, and is expected to return home early in September. (The London office of the company is at 88, Leadenhall Street, E.C.3.)

China's Output of Iron Ore and Pig-iron.—China's annual production of iron ore is estimated at 2,000,000 tons. Her annual pig-iron output is about 450,000 tons from Chinese-owned and operated furnaces and 250,000 tons from Japanese-owned furnaces.

PENMAN'S LADLES



GEARED CRANE LADLE.

Type F.

Penman & Company, Ltd.

Caledonian Iron Works,
GLASGOW.

Telegrams: PENMAN, GLASGOW

Telephone: BRIDGETON 41 & 42.

WEEKLY PRICE CURRENT.

COPPER.

	£	s	d.
Standard cash	63	10	0
Three months	63	12	6
Electrolytic	69	15	0
Tough	66	0	0
Best selected	66	0	0
Sheets	94	0	0
India	84	0	0
Wire bars	70	15	0
Do. Aug.	70	15	0
Do. Sept.	70	15	0
Ingot bars	70	15	0
H.C. wire rods	75	10	0
Off. aver. cash, July	63	3	7 3/16
Do. 3 mths., July	63	10	5 5/16
Do. Settlement July	63	3	2 1/4
Do. Electro, July	71	0	0
Do. B.S., July	67	0	0
Aver. spot price, copper, July	63	2	6
Do. Electro, July	71	13	7

Solid drawn tubes 13½d.
Brazed tubes 13½d.
Wire 10½d.
Yellow metal rods 6½d.
Do. 4x4 Squares 8½d.
Do. 4x3 Sheets 9½d

BRASS.

Solid drawn tubes 11¾d.
Brazed tubes 13½d
Rods, drawn 10¾d.
Rods, extruded or rolled 6½d.
Sheets to 10 w.g. 10d.
Wire 9¾d.
Rolled metal 9½d.

TIN.

	£	s	d.
Standard cash	160	5	0
Three Months	160	7	6
English	159	15	0
Bars	161	15	0
Chinese	159	0	0
Straits	161	5	0
Australian	160	10	0
Eastern	162	5	0
Banca	160	7	6
Off. aver., cash, July	156	4	4½
Do. 3 mths., July	156	14	5¼
Do. Sttlment July	156	4	2
Aver. spot, July	156	3	7

SPELTER.

	£	s	d.
Ordinary	31	5	0
Remelted	30	0	0
Hard	23	10	0
Electro 99.9	35	10	0
English	31	15	0
India	24	0	0
Prime Western	31	12	6
Zinc dust	48	0	0
Zinc ashes	9	0	0
Off. aver., July	28	18	5¼
Aver., spot, July	29	0	10¾

LEAD.

	£	s	d.
Soft foreign ppt	25	2	6
English	26	0	0
Off. average, July	24	6	11¼
Average spot, July	24	17	4½

ZINC SHEETS.

	£	s	d.
Zinc sheets, English	37	10	0
Do. V.M. ex. whf.	37	10	0
Dutch	37	10	0
Rods	42	0	0
Boiler plates	35	10	0
Battery plates	36	0	0

ANTIMONY.

	£	s	d.
English regulus	25	15	0
Special brands	32	10	0
Chinese	23	10	0
Crude	15	0	0

QUICKSILVER.

Quicksilver 11 15 0 to 11 17 6

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—
45/50% 12 17 6
75% 21 15 0
Ferro-vanadium—
35/40% 17/6 lb. va.
Ferro-molybdenum—
70/75% 6/6 lb. mo.
Ferro-titanium—
23/25%, carbonless 1/2 lb.
Ferro-phosphorus, 20/23%, £20
Ferro-tungsten—
80/85%, carbon free 1/5 lb.
Tungsten metal powder—
98/99% 1/9½ lb.
Ferro-chrome—
4/6% car. £23
6/8% car. £22 10
8/10% car. £22
Ferro-chrome—
Max. 2% car. £60
Max. 1% car. £68
Max. 0.70% car. £75
67/70%, carbonless 1/7 lb.
Nickel—99%, cubes or pellets £150
Cobalt metal—98/99% 10/6 lb.
Aluminium—98/99% £100
Metallic Chromium—
96/98% 5/- lb
Ferro-manganese (net)—
76/80%, loose £15
76/80%, packed £16
76/80%, export £14 10
Metallic manganese—
94/96%, carbonless 2/4 lb.
Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten s. 2 d. 6
Finished bars, 18% tungsten 3 0
Per lb. net, d/d buyers' works.

Extras—
Rounds and squares 3 in. to 8 in. inclusive 4d. lb.
Rounds and squares under ½ in. to ¼ in. 3d. lb.
Flats under 1 in. by ¾ in. to ¼ in. by ½ in., and all sizes over four times in width over thickness 3d. lb.
Bevels of approved sizes and sections 6d. lb.
If in coils 3d. lb.
Packing £3 ton.
Bars cut to length 10% extra

Scrap from high-speed tool steel—
Scrap pieces 3d.
Turnings and swarf 1d.
Per lb. net, d/d steel makers' works.

SCRAP.

South Wales—	£	s.	d.	£	s.	d.
Heavy Steel	3	8	6	3	15	0
Bundled steel & shearings	2	17	6	3	7	6
Mixed iron & steel	2	17	6	3	5	0
Heavy cast iron	3	7	6	3	15	0
Good machinery for foundries	3	17	6			
Cleveland—						
Heavy steel	3	2	6			
Steel turnings	2	5	0			
Cast-iron borings	2	5	0			
Heavy forge	3	12	6			
Bushelled scrap	3	2	6			
Cast-iron scrap	3	12	6			
Lancashire—						
Cast iron scrap	4	0	0			
Heavy wrought	3	10	0			
Steel turnings	2	2	6			

London—	£	s.	d.
Copper (clean)	57	0	0
Brass (clean)	31	0	0
Lead (less usual draft)	20	0	0
Tea lead	18	0	0
Zinc	17	0	0
New aluminium cuttings	60	0	0
Braziery copper	47	0	0
Gun metal	41	0	0
Hollow pewter	125	0	0
Shaped black pewter	80	0	0

Above are merchant's buying prices delivered yard.

PIG-IRON.

N. E. Coast—	
Foundry No. 1	95/-
Foundry No. 3	87/-
Forge No. 4	83/-
Mottled	80/-
Hematite No. 1	90/6
Hematite M/Nos.	90/-
Midlands—	
Staffs. common	—
„ part-mine forge	—
„ „ foundry	—
„ Cold blast	240/-
„ basic	—
Northants forge	70/- to 72/6
„ foundry No. 3	77/6 „ 80/-
„ basic	82/6
Derbyshire forge	75/-
„ foundry No. 3	82/6
„ basic	80/-
Scotland—	
Foundry No. 1	100/-
„ No. 3	95/-
Hematite M/Nos.	107/6
Sheffield (d/d district)—	
Derby forge	82/6
„ foundry No. 3	86/6
„ basic	—
Lincs. forge	86/6
„ foundry No. 3	86/6
„ basic	86/6
E.C. hematite	101/2
W.C. hematite	104/-
All d/d in the district.	
Lancashire (d/d eq. Man.)	—
Derby forge	—
„ foundry No. 3	92/6
Northants foundry No. 3	—
Cleveland foundry No. 3	—
Staffs. foundry No. 3	—
Lincs. forge	—
„ foundry No. 3	—
Summerlee foundry	112/-
Glengarnock foundry	114/6
Gartsherrie foundry	114/6
Monkland foundry	112/-

FINISHED IRON & STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.
Bars (cr.)	£10 10 to 11	10	0
Angles	£11 to 11	10	0
Tees to 3 united ins.	£11 10 to 12	0	0
Nut and bolt	9	17	6
Hoops	14	0	0
Marked bars (Staffs.)	13	10	0
Gas strip	11	2	6
Bolts and nuts, ¾ in. × 4 in.	19	10	0
Steel—			
Ship plates	9	0	0
Boiler plates	12	10	0
Chequer plates	10	10	0
Angles	8	15	0
Tees	9	12	6
Channels	8	10	0
Joists	9	0	0
Rounds & squares 3-in. to 5½in.	10	10	0
Rounds, under 3in. to ¾in.	9	10	0
Flats, over 5in. wide and up	10	0	0
Flats 5in. to 1¼in.	8	10	0

	£	s.	d.
Rails, heavy	8	15	0
Fishplates	14	10	0
Hoops	11	15	0
Black sheets, 24 g.	12	0	0
Galv. cor. sheets, 24 g.	16	5	
Galv. fencing wire, 8 g. plain	16	0	0
Rivets, ½ in. dia	14	0	0
Billets, soft	7 0 0 to 7	5	0
Billets, hard	8	0	0
Sheet bars	7 5 0 to 7	7	6

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	1 3
Sheet	1 3¾
Wire	1 3½
Rods	1 2½
Tubes	1 6
Castings	1 1

Delivery 3 cwt. free to any town.
10% phosphor copper, £40 above price of B.S.
15% phosphor copper, £50 above price of B.S.
Phosphor tin (5%), £30 above price of English ingots.
Charles Clifford & Son Limited, Birmingham.

NICKEL SILVER, SHEET METAL, WIRE AND TUBES.

	Per lb.
Ingots for raising	11d. to 1/5
Rolled—	
To 9 in. wide	1/5 to 1/11
To 12 in. wide	1/5½ to 1/11½
To 15 in. wide	1/6 to 2/0
To 18 in. wide	1/6¾ to 2/0¾
To 21 in. wide	1/7½ to 2/1½
To 25 in. wide	1/8¼ to 2/2¼
Ingots for spoons and forks	11d. to 1/5
Ingots rolled to spoon size	1/2 to 1/8
Wire round—	
3/0 to 10. G.	1/8½ to 2/3½

with extras according to gauge

AMERICAN IRON & STEEL.

At Pittsburgh unless otherwise stated.	Dols.
No. 2X foundry, Phila.	31.14
No. 2 foundry Valley	29.00
No. 2 foundry, Birm.	19.50
Basic	27.96
Bessemer	28.76
Malleable	29.96
Grey forge	28.76
Ferro-manganese 80 % delivered	70.82
Bess. rails, h'y, at mill	40.00
O.-h. rails, h'y, at mill	40.00
Bess. billets	35.00
O.-h. billets	35.00
O.-h. sheet bars	35.00
Wire rods	40.00
	Cents.
Iron bars, Phila.	2.02
Steel bars	1.80
Tank plates	1.80
Beams, etc.	1.86
Skelp, grooved steel	1.80
Skelp, sheared steel	1.80
Steel hoops	2.50
Sheets, black, No. 28	3.15
Sheets, galv., No. 28	4.15
Sheets, blue an'l'd, 9&10	2.40
Wire nails	2.40
Plain wire	2.25
Barbed wire, galv.	3.05
Tinplate, 100-lb. box	$4.75

COKE (at ovens).

Welsh foundry	35/-
„ furnace	30/-
Durham & North. foundry	28/-
„ furnace	23/6
Other Districts, foundry	27/6
„ furnace	22/6

SWEDISH IRON.

Bars, hammered basis sizes Basis price £22 to £23

	£ s. d.
Rolled Ordinary— Assortment ..	17 0 0 to 17 10 0
Nail Rods— Square, round and flats ..	

Keg Steel nom. £38 to £40
Faggot Steel nom. £30 to £32

Blooms—
Single welded .. £10 to £11

Billets—
Single and double welded £13 to £14

Pig-Iron—
Grey, white or mottled .. £8 to £8 15 0

Prices are without engagement. All quotations are f.o.b. Gothenburg, net cash against documents there.

TUBES.

Up to and incl. 6 in.

Gas	.. 55%	Tube prices are now free.
Water	.. 50%	
Steam	.. 45%	

TINPLATES.

I.C.Cokes,	20×14, box	19/3
„	28×20, „	38/10½
„	20×10, „	27/9
„	18¾×14, „	19/9
I.X.	„	45/6
I.X.X.	„	52/-
F.C.B.Y.	21×13⅝ „	37/-
C.V.B.G.	16¾×15, „	35/6
I.C.W.	20×14, „	17/-
„	28×20, „	34/3
„	20×10, „	23/3
„	18¾×14, „	18/1½
Terneplates,	28×20, „	35/6

DAILY FLUCTUATIONS.

Standard Copper (cash).

	£	s.	d.		
Aug. 16	64	5	0	inc.	7/6
„ 17	64	0	0	dec.	5/-
„ 18	63	17	6	„	2/6
„ 21	63	15	0	„	2/6
„ 22	63	10	0	„	5/-

Electrolytic Copper.

Aug. 16	70	5	0	inc.	5/-
„ 17	70	0	0	dec.	5/-
„ 18	70	0	0	No change	
„ 21	69	15	0	dec.	5/-
„ 22	69	15	0	No change	

Standard Tin (cash).

Aug. 16	160	12	6	inc.	35/-
„ 17	161	10	0	„	17/6
„ 18	161	12	6	„	2/6
„ 21	161	2	6	dec.	10/-
„ 22	160	5	0	„	17/6

Tin (English ingots)

Aug. 16	160	10	0	inc.	35/-
Aug. 17	161	10	0	inc.	20/-
„ 18	161	10	0	No change	
„ 21	161	0	0	dec.	10/-
„ 22	159	15	0	„	25/-

Zinc Sheets (English).

Aug. 16	37	10	0	No change
„ 17	37	10	0	„
„ 18	37	10	0	„
„ 21	37	10	0	„
„ 22	37	10	0	„

Spelter (ordinary).

Aug. 16	31	10	0	inc.	5/-
„ 17	31	12	6	„	2/6
„ 18	31	10	0	dec.	2/6
„ 21	31	12	6	inc.	2/6
„ 22	31	5	0	dec.	7/6

Lead (English).

Aug. 16	26	0	0	No change	
„ 17	26	0	0	„	
„ 18	26	0	0	„	
„ 21	26	0	0	„	
„ 22	26	0	0	„	

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London: 10, Bush Lane, Cannon St., E.C.4.

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Sunbrand (Cannon), London.

Telephone:—
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5959 Central.

BARS, HOOPS, SECTIONS & WIRE
in IRON, STEEL, COPPER and BRONZE.

Galvanised Telegraph, Telephone, Cable and Trolley Wire
To all Specifications.

Contractors to H.M. Government (Admiralty, G.P.O., India Office, War Office, Colonies), English and Foreign Railways, &c.

BEST H. C. COPPER & BRONZE WIRE a speciality.

Medals:—Sydney (Bronze) 1879, New Zealand (Gold) 1882, Liverpool (Silver) 1886, Adelaide (Gold) 1887, Franco-British Grand Prix (Highest Award) 1908.

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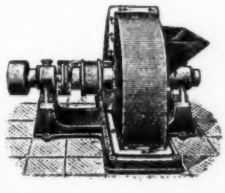

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CAPACITIES:
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FOREMAN PATTERNMAKER, specialising in Machine Moulding, seeks engagement with progressive firm; first-class references.—Replies to Box 234, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

PATTERN MAKER. Age 30. Large experience in both shop and foundry, desires to obtain employment in modern or progressive foundry where thorough knowledge of machine and plate moulding and foundry work can be obtained, also facilities for studying production and economy desirable.—Apply, TYNESIDER, Offices of the FOUNDRY TRADE JOURNAL, 5, Duke Street, Adelphi, London, W.C.2.

MOULDER, 12 years' experience Aluminium and Brass, over 2 years as Pattern Plate Moulder for Machine Moulding, for British and French machines, including Britannia, and Bonvillain and Ronceray, seeks position, any district.—Box 240, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

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THE BRITISH CAST IRON RESEARCH ASSOCIATION

Appointment of Director of Research.

The Council invite applications for the post of Director of Research of the Association at a commencing Salary not exceeding £900 per annum, according to Scientific attainments, and Foundry, Blast Furnace or other suitable Industrial experience.

Forms of application can be obtained from the undersigned, which are to be returned on or before August 31st, 1922.—THOMAS VICKERS, Secretary, Central House, New Street, Birmingham.

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FOR SALE.

Two new Thompson Dish-ended Lancashire Boilers, 30 ft. x 8 ft. 3 in., for 150 lbs. pressure. Three Lancashire Boilers, 30 ft. x 7 ft. 6 in., now insured at 150 lbs. pressure. Two Cornish Boilers, 28 ft. x 6 ft. diameter, reinsure 90 lbs. pressure. Four Marine Water Tube Boilers, by Yarrow, Limited, each 4,000 sq. ft. heating surface, reinsure 200 lbs. pressure. One Loco Type Boiler, barrel 7 ft. 6 in. long x 3 ft. diameter, reinsure 80 lbs. pressure. One Vertical Boiler, 6 ft. 6 in. x 3 ft. 9 in. diameter, reinsure 80 lbs. pressure. One Hornsby Waste Heat Water Tube Boiler, about 40 h.p., reinsure 160 lbs. pressure. Air Receivers, 6 ft. x 2 ft. 6 in., tested to 90 lbs. pressure, with safety valve, drain cock, etc.

Catalogue of Stock Machinery, 5-6,000 Lots. Free on Application. Inspection Invited.

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ONE 20-in. CENTRIFUGAL FOUNDRY SAND MIXER, capacity 1 to 2 tons per hour, fitted with latest improvements and equal to new.—Price and particulars on application to C. E. V. HALL, 26, Paradise Square, Sheffield.

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CUPOLAS! CUPOLAS!! CUPOLAS!!!—Fifteen Riveted Steel Cylinders, as new, 18 ft. x 2 ft. 6 in.; would make excellent Cupolas, complete with Steel Girder Framework Pipes and Air Ducts; £300 the lot, f.o.r. Details, Drawings.—HARRY H. GARDAM & COMPANY, LIMITED, Staines.

NEW WELDING PLANT, with Acetylene Generator, six blowpipes, etc., ready for use, £17 5s.; complete new Cutting Plant, £15 10s. Lists free.—STANSELL'S ACETYLENE COMPANY, LIMITED, Exeter.

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Within 2 miles of Kettering (M.R. main line); 7 miles from Wellingborough; Cranford Station (M.R.) and Butlins Sidings adjoining.

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To be Offered for Sale by Auction as a whole, or in 2 lots (if not previously disposed of by private treaty), by

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Expert metallurgical, analytical and consulting service given by old-established firm of metallurgical chemists (chemical analysis, general foundry work, mixtures, research, etc.). Write at once for lists and details.—BEECROFT & PARTNERS, LIMITED, Valley Road, Chesterfield; also at Norfolk House, Cannon Street, Birmingham.

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Two NEW sand mixers, largest size, by GREEN.	£30 each
Pneumatic sand sifter by Consolidated Pneumatic Tool Co.	£18
Belt driven sifter, good machine	£8
4 foot sand mill, double reduction gear, a really first class machine	£30
Four small **turnover** moulding machines by J. C. L. J. W. Phillips.	£14 each
2½ ton Evans crane ladle, as new.	£38
NEW double-ended shanks, 2½ cwt.	£5 each
NEW single-ended shanks, 2 cwt.	£4 each
NEW single-ended shanks, 1 cwt.	£3 each
NEW hand ladles	£1 each

A Stock of foundry small tools, crucible tongs, moulding boxes and machines can always be viewed here.

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